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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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Orthodontic Appliances—*Casto*
Vincent's Infection—*Rosenthal*
Denture Construction—*Flagstad*
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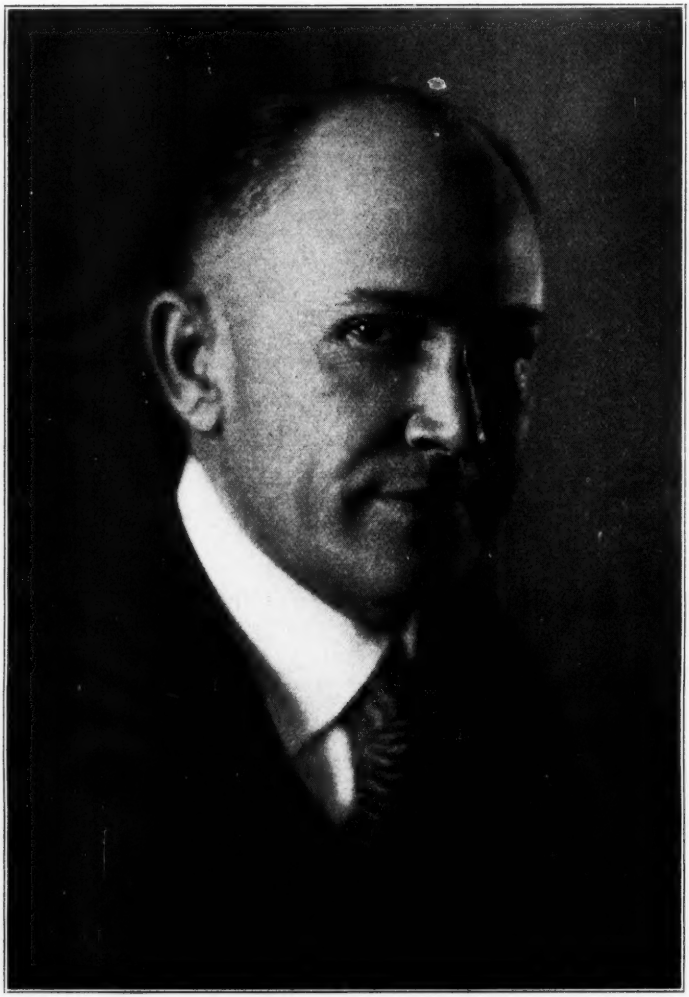

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UNIV OF MICH

THE JOURNAL
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Vol. 20 MARCH, 1933 No. 3

Original Communications

DEVELOPMENT OF THE HUMAN JAWS AND SURROUNDING STRUCTURES FROM BIRTH TO THE AGE OF FIFTEEN YEARS*

By WILLIAM H. G. LOGAN, M.S., M.D., D.D.S., F.A.C.S., and RUDOLF KRONFELD, M.D., Chicago, Ill.

NEED OF THIS STUDY IN THE PROBLEMS OF ORAL SURGERY

THIS study was originally undertaken to ascertain exact data as to the minute structure of the maxilla in early infancy. The importance of such an investigation was evident from the observation that underdevelopment of the jaws and irregularities of the teeth were frequently associated with early surgical treatment of complete congenital cleft of the upper jaw and lip. The etiology of underdevelopment and irregularities in these cases could not be evaluated without a thorough knowledge of the normal, as well as the abnormal structures that have to be considered in the surgical correction of congenital clefts. The span of life that was deemed most important in this investigation lay between birth and 6 months, and originally the specimens studied were confined to this particular period. However, it was anticipated that if suitable human material could be secured, the study would be continued at least up to the twenty-fourth month, which would include the period when the majority of operators by preference perform the Langenbeck operation following the lip closure in the early days of infancy.

When the first serial sections of such jaws were prepared, more than three years ago, it soon became evident that the findings as to these specimens were not entirely in accord with the statements made by past and present-day histolo-

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*Read at the Third General Meeting of the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

gists. This was especially true with reference to the topography and development of the deciduous and permanent teeth. Therefore, it seemed desirable to extend the study far beyond the original age limit. Thus, the present investigation has been pursued from birth to the full development of the deciduous teeth, their eruption and shedding, as well as the development and position of the permanent tooth germs from birth until their full eruption (with the exception of the eruption of the third molars), namely, to the age of 15 years. Also, a careful study of the manner and method of tooth germs during the early years of life had been disclosed, it was natural to assume that not only the general practitioner of dentistry, but also those engaged in the specialties of orthodontia, exodontia, pedodontia and dietetics, as well as the dental oral surgeon, could with advantage make use of knowledge regarding this important early period when so much can be done to benefit or, on occasion, to interfere with the proper development of these structures. It is probable that at no period during life is it more essential that the dentist or physician in charge be conversant with

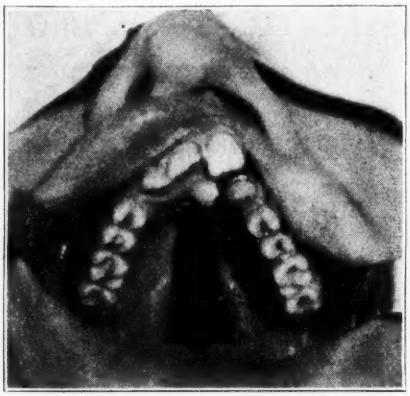

Fig. 1.—Complete cleft of upper jaw and lip with minor underdevelopment and irregularity of teeth in patient, aged 17 years. No operation on palate or lip was ever performed. (Author's case.)

bone growth during this developmental period has been included.

As previously indicated, the study was initiated with the thought that the findings, if they should prove of merit, would be of interest only to that small group of surgeons who are called on to correct congenital clefts of palate and lip. However, since a large number of new data with regard to the time of calcification of the various teeth and the position of the deciduous and permanent the histologic and physiologic factors in the normal development of the patient than in early infancy. As a single example, we take the liberty of calling attention to the widespread interest and discussion at this time of the indications for a given type of diet for tooth development.

Likewise, it would seem to be not only of interest, but also of value, for the orthodontist to know the position and anatomic relationship of the deciduous

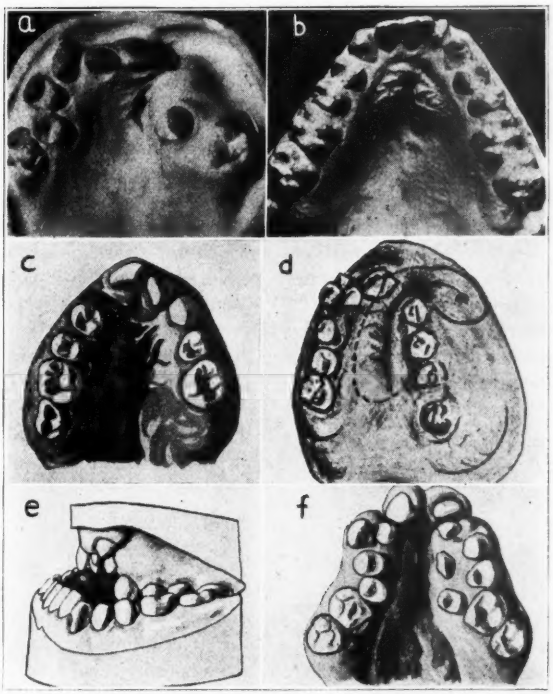

Fig. 2.—*a*, major underdevelopment of upper jaw associated with complete cleft in patient, aged 12 years. There is marked irregularity of the teeth and several permanent teeth are absent. Closure of the lip was done on the fourth day of life. The first operation on the palate was a modified Langenbeck, at age of 5 years. Wires were not carried through the bone in the surgical correction. (Author's case.)

b, complete cleft of upper jaw and lip. Surgical correction was made by the Brophy technic during the third month, with the lip operation at the fourth month and soft palate operation, the twentieth month. There was relatively normal development of the jaw and normal alinement of teeth. (Authors' case.)

c, minor underdevelopment of upper jaw with complete cleft of the palate. Several teeth are missing. The patient was operated on in early infancy, silver wires being employed through the substance of the bone and lead plates adapted to the jaw (Brophy method). (Rosenthal.)

d, major underdevelopment of upper jaw and irregularity of teeth, early Langenbeck operation. Wires or lead plates were not used in the surgical correction. (Rosenthal.)

e, major underdevelopment of upper jaw, with marked irregularity of teeth. Early lip and palate operation was performed. Wires or lead plates were not used in the surgical correction.

f, palatal view of same case. (Rosenthal.)

and permanent teeth from the time the first deciduous tooth erupts, and be informed more definitely than he now is with regard to the date of calcification of each permanent tooth; for we have learned that there is not a uniform relation between the beginning and completion of calcification and the eruption of

the various permanent teeth. The most outstanding examples of this are found in the beginning of calcification and the eruption of the upper permanent lateral incisor, and, to a slightly lesser degree, this holds true of the bicuspid teeth.

Having referred to the importance of this study to the general practitioner of dentistry, as well as to certain special groups, we desire to deal briefly with one of the primary reasons for the selection of this research problem.

Since 1890, or a short time after Truman W. Brophy first performed the operation for the surgical closure of complete cleft of the upper jaw by passing

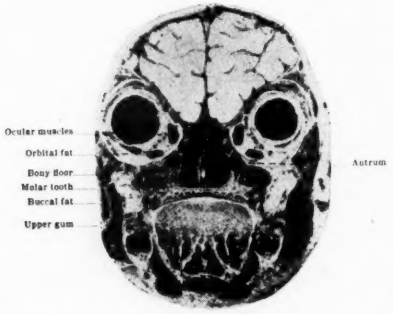

Fig. 3.—Coronal section through antrum of frozen head of an infant at term. There is only a thin plate of bone between the tooth sac and the orbit, and, in transfixing the maxilla, the needle must penetrate one of them. The antrum is still very small and lies mesiad from the tooth sac of the second molar tooth. From the arrow points, it will be seen that the upper jaw is narrower than the lower. (Blair.)

silver wires through the substance of the bone and carrying the borders of the cleft in contact through the divided maxillary ridges by twisting silver wires over supporting lead plates, there has been a controversy over accepting the principles of the direct application of force in preference to the indirect application of force; i.e., operating on the lip and permitting its muscular action to reduce the width of the cleft through its anterior part.

The senior contributor to this study (W. H. G. L.) performed his first operation in accordance with the Brophy technic over thirty years ago, and continued to employ this technic until after the present study was initiated, from which time the application of the principle has been continued, but there has been a modification of the technic. Therefore, quite naturally, an interest in the direct application of force has been sustained throughout this entire period. Often, opportunity was granted to observe as they grew into adult life patients in whom the direct application of force had been employed, and the results were all that were expected by those favoring this type of procedure. On the other hand, certain patients operated on according to the same technic and by the same surgeons showed marked irregularity of the teeth and underdevelopment of the upper jaw, and our natural deduction was then the same as that of the opponents; namely, that this underdevelopment and irregularity were wholly due to the direct application of force.

As years passed, it was observed that underdevelopment of the upper jaw with complete cleft and marked irregularity of the teeth was not necessarily associated only with varied types of surgical procedure, but, in fact, was seen to occur in such cases as the one presented in Figure 1, a photograph of the mouth of a 17-year-old patient with complete cleft of the upper jaw and lip with definite underdevelopment and irregularity of teeth from the bicuspid forward (the lateral incisor erupting high up in the cleft), and no surgical interference either to palate or lip previous to 18 years of age.

Even more marked deformity and un-

derdevelopment of the upper jaw and irregularity of the teeth associated with complete cleft of palate and lip are shown in Figure 2, *a*. The lip was operated on the fourth day of life and the palate operations had been performed at later intervals. This patient shows major irregularity of the permanent teeth, a number of which are absent. Attention is called to the contraction of the maxilla in the bicuspid region, a condition that is often present after an early Langenbeck operation. (Fig. 2, *e* and *f*.) The contention is not made that this operation was the only factor in producing such a deformity.

An entirely different clinical picture is found in the case of a complete cleft that was operated on after Brophy's method (direct application of force) in the third month of life. (Fig. 2, *b*.) All upper permanent teeth erupted normally and are in satisfactory alinement except for a rotation of the left lateral incisor that was in the line of the cleft through the alveolar process. But there are also cases where wiring through the bone was followed by considerable malformation of the maxilla and by irregularity and absence of teeth. A case of the latter type is illustrated in Figure 2, *c*. Very similar deformities have also been observed in which the lip was operated on in infancy and no wires had been passed through the bone of the divided jaw. (Fig. 2, *d*.)

An example of extreme malformation and underdevelopment of the maxilla is shown in Figure 2, *e* and *f*. In this case, the palate was operated on at the age of 2 years after the method of Langenbeck. No wires were used in the surgical correction. Not only is there a very marked reduction in the anteroposterior length of the maxilla, but there is also great irregularity of the teeth and transverse contraction of the jaw. The premaxilla is not united with the lateral segments of the jaw.

Thus we became impressed with the importance of a histologic study of the normal upper jaw at various ages from birth to 24 months in determining the location of the deciduous and permanent germs of the teeth during that time, and the relation of these tooth germs to the

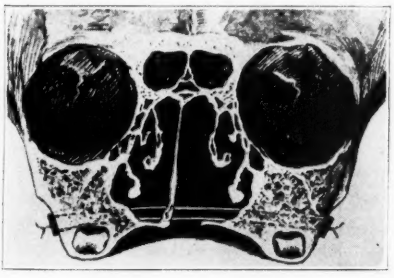

Fig. 4.—Sagittal section of bones of face showing cleft of hard palate with silver sutures and lead plates adjusted. (Brophy.)

Figures 4 and 5 afford a comparison of the diagrams of Brophy and Treves, illustrating the position of the silver wires in the maxilla in case of direct application of force in surgical correction of cleft palate.

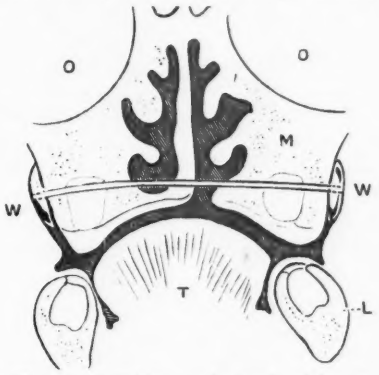

Fig. 5.—Brophy's method of wiring for cleft palate. *O*, orbital cavity; *M*, upper jaw; *L*, lower jaw; *T*, tongue; *W*,*W*, silver wire (relation of which to teeth sacs, which must be damaged, may be noted). (Treves.)

floor of the nasal fossa and all important landmarks which might aid those interested in the surgical correction of cleft of the palate.

With this presentation of evidence of the lack of uniformity of the erupting deciduous and permanent teeth and bone development when either direct or indirect force has been applied, as well as similar underdevelopment of bone and irregularity of teeth when there has been no surgical interference previous to the eighteenth year (Fig. 1), and with the further realization that we have been without knowledge as to the exact location of the germs between birth and 6 months of age (the latest period when this operation can wisely be performed by the wire and lead plate method), we believe that all workers in this field will welcome information concerning not only the location of the deciduous

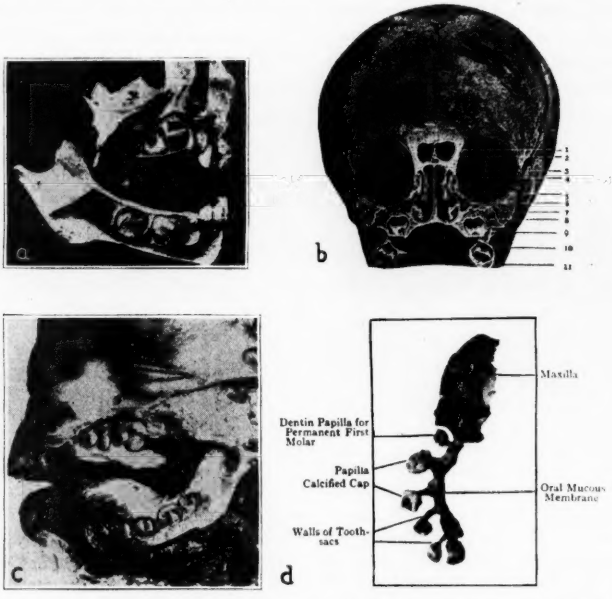

Fig. 6.—Previous information about location and development of human teeth in early life.

a, maxillae at about eight months after birth, showing unerupted teeth. (Noyes.)

b, skull of a fully developed embryo cut vertically through first deciduous molars. *1*, anterior fossa of brain case; *2*, crista galli; *3*, orbit; *4*, nasal septum; *5*, ostium maxillare; *6*, maxillary sinus (antrum); *7*, malar bone; *8*, maxilla; *9*, dental germs; *10*, mandible; *11*, hard palate. (Cryer.)

c, dissection of upper and lower jaws, exposing unerupted teeth. The photograph of this cadaver shows the external alveolar plate removed. The position of the teeth indicates that a well-directed needle or drill can easily be carried between them without disturbing them. The needle or drill should be so used that the flat side will slip in between the teeth. In penetrating the tissues, the expert hand will easily detect the difference between tooth and bone. When the instrument comes in contact with the teeth, it should be directed first forward and then backward until it slides between the teeth and passes through the tissues. (Brophy.)

d, soft tissue lining detached from palate and tooth follicles removed from their crypts. (Broomell and Fischelis.)

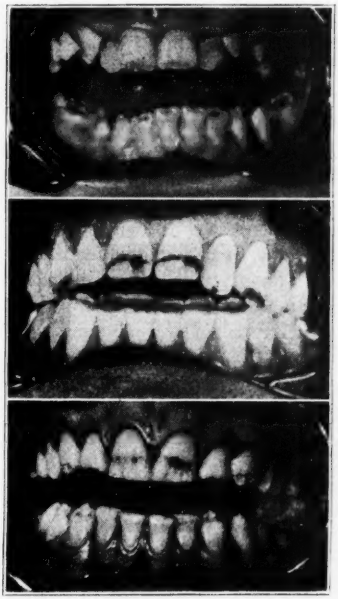

Fig. 7.—Various degrees of enamel hypoplasia showing differences in involvement of lower and upper teeth.

Above, the incisal fourth of the upper central incisors and of the lower central and lateral incisors, and the occlusal portion of all four first permanent molars, are affected. The upper lateral incisors and the upper and lower cuspids are not affected. (Table 3, *I.*)

In the center, the incisal third of the upper central incisors and of the lower central and lateral incisors are all affected approximately to the same extent. All four cuspids are affected to a slightly lesser extent than are the central incisors. The upper lateral incisors are nicked at the very incisal edge.

Below, advanced hypoplasia is evident. About one half of the enamel of the upper central incisors and of the lower central and lateral incisors is affected and about one third of the enamel of all four cuspids. The incisal fourth of the crowns of the upper lateral incisors was hypoplastic and is missing. The bicuspids are not involved. (Table 3, *III.*)

tooth germs, but also the normal relation of the maxillary and mandibular ridges between the cuspids.

Although photographs of models and specimens of fully developed fetuses and human skulls (Fig. 6, *b*) are available which reveal the relationship existing between the maxillary and mandibular ridges through the line of the deciduous molars and the location of the deciduous teeth in frozen specimens (Fig. 3), there has never been submitted a series of models or specimens which revealed the normal position of all teeth in early infancy or the relationship of the tuberosities to the mandibular ridge. Neither is there any information available as to the minute anatomic structure of the ridge at the point where the cleft usually divides the upper jaw. Yet this knowledge is of equal importance to determine the position of the teeth or the location of the tuberosities under normal and abnormal conditions.

A vital question bearing on the importance of accepting or rejecting the methods now in vogue for the direct or indirect application of force to establish either bony or soft tissue union, or just contact of the cleft through the mandibular ridge and reduction of the width of the cleft posteriorly, depends on the ability of the operator to make use of these forces in such a manner as not to cause destruction or irregularity of the germs of the permanent teeth; also to avoid carrying the maxillary ridge inside the mandibular ridge between the cuspids, with the resultant flattening of the upper jaw and the teeth erupting to the lingual aspect of the lower incisors; and, of greater importance, to secure an improvement in the speech end-results over those obtained in the past.

Many advocates of the direct application of force have contended that if the

wires were placed high or between the deciduous teeth, marked irregularity of permanent teeth would always be avoided. The reader is referred to a drawing in Dr. Brophy's textbook on oral surgery, illustrating the position of the silver wires in the jaw bone and their relationship to the deciduous molar tooth germs and other adjacent structures (Fig. 4); but no information is submitted as to the position of the germs of the bicuspid teeth that are to replace their deciduous predecessors. In this illustration, the tion of the bicuspid teeth that were to replace their deciduous molars. Another interesting item about the Treves' drawing is that the deciduous tooth germs are placed on a higher level than that indicated by Brophy and are lengthened to a degree to cause them to be exactly in the line of the wire if placed at the level suggested in the drawing by Brophy. Therefore, Treves concluded that the tooth sacs must be damaged during the operation. Figures 4 and 5 have been extensively copied by advocates and op-

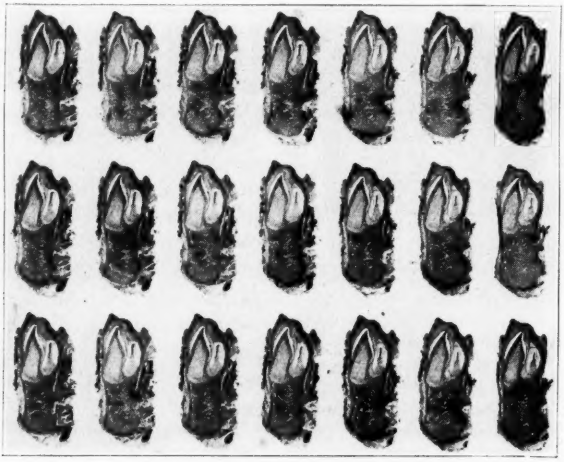

Fig. 8.—Histologic slide with twenty-one labiolingual serial sections through lower deciduous and permanent central incisors at age of 6 months. (Sections original size.) Figure 21, left, shows a higher magnification of one of these sections.

wires are visible in the field between the floor of the orbit and above the germs of the deciduous molars. The space represented in this area has been greatly exaggerated by the artist as can be plainly seen by comparing Figure 4 with Figure 24, above. Treves, who objected to Brophy's method of using silver wires to reduce a congenital cleft, published a similar diagram (Fig. 5); but he, like Brophy, gave no indication as to the posiponents of the direct application of force to prove their contentions. Yet no one has made a study of the histologic facts to a degree that would authorize him in reaching a conclusion as to whether there was any definite location where, in passing through the jaws, wires would automatically come in contact with or miss the tooth germs and avoid entrance into the orbital cavity or other important structures in this general field.

It would seem that the foregoing statements must hold true except for such knowledge as one would gain from practical experience. Furthermore, all, we believe, will agree that the presentation of evidence regarding the location of the germs of all teeth and the establishment of definite landmarks for surgical guidance should be the basis for any claim that one can pass wire sutures at any point through those structures and not cause serious injury to the teeth. After following this study for over a period of years, it is easy to understand why some patients have little or no irregularity of teeth as the result of direct application of force (by silver wires and lead plates), while others have not been equally fortunate. Evidence also seems to have been found as to why there is sometimes a flattening of the bone immediately beneath the nose for a part of the distance between the cuspids in the maxilla, while, in other instances, the maxillary ridge and anterior teeth are normal. We have been without fundamental knowledge as to the cause of this in the past, as we have never known quite positively what were the major contributing factors in the ideal or the unfavorable end-results.

INFORMATION CONCERNING THE DEVELOPMENT OF TEETH AND JAWS IN EARLY CHILDHOOD AVAILABLE AT THE TIME THIS STUDY WAS INITIATED

Before presenting the findings in our study of twenty-five human jaws which varied in age from birth to 15 years (nineteen of which were 2 years or under), it is interesting to review the opinions of the accepted authorities in dental histology as they bear on the question under consideration, and, at the same time, delineate the different procedures employed by them.

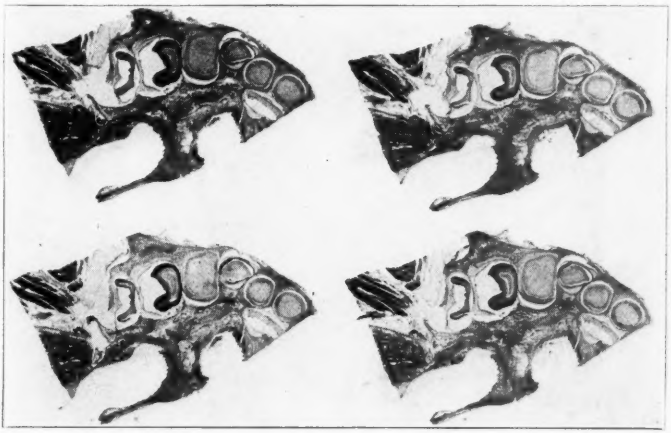

Fig. 9.—**Histologic slide with four horizontal serial sections through one-half the maxilla at the age of 6 months. (Sections original size.) Figure 18, left, shows a higher magnification of one of these sections.**

Knowledge of the development and topography of the deciduous and permanent teeth in the first and second decades of life can be gained through different

methods. The value and limitation of each method will be discussed briefly.

Only one form of investigation of this problem can be used in living human beings, namely, roentgenographic examination of the jaws at regular intervals and a comparative study of the findings in identical areas at different ages. Such roentgenographic studies are of great value because they aid in visualizing the changes occurring in the same individual. The limitations are that, in the first months and years after birth, good roentgenograms are extremely difficult to obtain owing to lack of cooperation by the patient. Furthermore, we have found that the germs of the human teeth undergo important developmental changes and reach a considerable size before calcification begins; and, for this reason, the roentgenograms cannot give the required information about the early stages of tooth development, especially during the first months of life.

In our own study, we have used roentgenographic examination of the specimens extensively, and we have been particularly interested in correlating our microscopic findings, as far as it has been possible to do so, with these roentgenographic observations. Thus, we have worked under far more favorable conditions than has the clinician who deals with the living human being, because our specimens allowed an unlimited variety of favorable positions for roentgenographic exposure. (Figs. 16 and 23.)

Another method for the study of tooth germs employed by others was the examination of human skulls. In skulls of young children, it is usually necessary to remove the outer bony plate of maxilla and mandible to gain access to the germs in their bony bed. (Fig. 6, *a*.) Such specimens are illustrated in most textbooks on dental histology. In Noyes' textbook, the development of teeth and jaws from birth to adult life is illustrated by means of such skulls. Mummery, in his textbook, used the same type of speci-

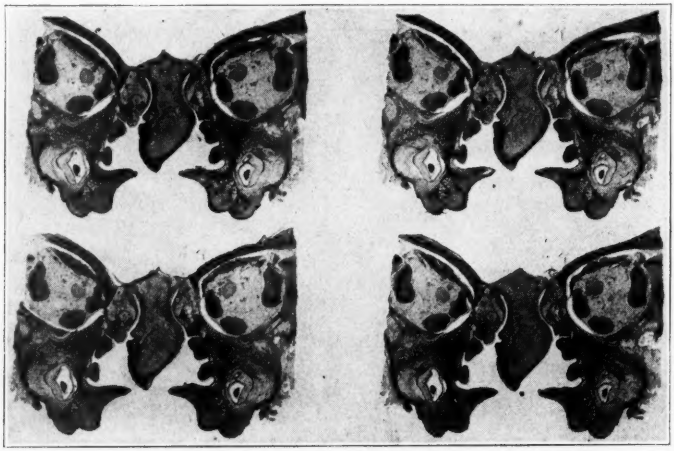

Fig. 10.—Histologic slide with four frontal serial sections through head of new-born child with cleft through soft and hard palate. (Sections original size.)

mens and for the same purpose. Although these dry specimens illustrated clearly the position of developing teeth in somewhat more advanced stages, they are not satisfactory for the study of the early stages, especially of the permanent teeth during the first and second years of life. (Fig. 6, *b*.)

tory because the soft tissues overlying the jaws have been removed. In order to retain these important soft structures, anatomic specimens were prepared by certain investigators by dissecting the germs from jaws of cadavers. Specimens of this type were illustrated by Stone and Brophy. (Fig. 6, *c*.) The most detailed study

Fig. 11.—Histologic slide with four frontal serial sections through entire width of maxilla of child of 9 months in region of deciduous molar. (Sections original size.) Figure 24, below shows a higher magnification of one of these sections.

For the study of tissues that are important in connection with dental problems, as well as with those of oral and plastic surgery of the mouth and jaws, bone specimens are not entirely satisfac-

of human tooth germs by the use of gross anatomic dissection was made by Broomell and Fischelis. These last named authors removed the tooth follicles from their bony crypts, together with the over-

Fig. 12.—Sagittal sections through head and neck of a child, 6 weeks old. Colored photograph of the actual hematoxylin and eosin-stained specimens, 1.6 times the original size of the section. The section above runs through a sagittal plane about 3 mm. to the right of the median line of the face; consequently, the upper central incisors are visible. The section below runs through the median line (nasal septum) between the upper central incisors. The mandible was not exactly in centric relation at the time of death and fixation, and therefore, in the sections, the median line (symphysis) of the mandible does not coincide with the median line of the upper jaw. (The color halftones for Figure 12 were furnished by the authors.)

Above: Section through sagittal plane. For easier orientation and description, the specimen may be divided into three levels: upper and dorsal level, containing the tissues located above the nasal cavity and behind the esophagus; middle level, containing the tissues separating the nasal and oral cavity, and lower level, containing the tissues located below the oral cavity and in front of the esophagus.

1. The tissues of the upper and dorsal level enumerated in anteroposterior order are:

Nose. The nasal cartilage may be recognized by its color, blue. A tangential section through the inferior concha is shown.

Base of skull; body of sphenoid bone; on its upper surface, pituitary fossa containing hypophysis cerebri. In front of the hypophysis, the optic chiasm is visible in cross-section.

Posterior to the body of the sphenoid, the large cartilaginous mass (blue) of the sphenooccipital synchondrosis is visible. Then follows the basilar process of the occipital bone, the atlas and the epistropheus, and the bodies of the first three cervical vertebrae. The body of each vertebra consists of a peripheral mass of hyaline cartilage (blue) and of a central nucleus of bone (purple).

At the lower surface of the sphenoid at the root of the nasopharynx lies the pharyngeal tonsil (adenoid tissue, stained deep purple). Below, the superior middle and inferior constrictor muscle of the pharynx form the dorsal wall of the pharynx and are continuous with the muscular wall of the esophagus.

2. Tissues of the middle level enumerated in anteroposterior order are:

Upper lip; lower border of nostril; germ of deciduous central incisor and behind it the germ of the permanent central incisor.

Hard palate; soft palate; uvula. In the soft palate, one can differentiate between the upper (nasal) portion consisting of muscles and the lower (oral) portion consisting of glands.

3. Tissues of lower level enumerated in anteroposterior order are:

Lower lip; mandible showing a tangential section through the germ of the lower deciduous central incisor. In the angle between mandible and tongue, the opening of the sublingual and submaxillary ducts is visible.

Tongue. The tongue occupies the entire oral cavity. Its major portion is located in a level above the mandible, filling the concavity of the vault. Muscles of the tongue are visible: the genioglossus muscle, originating from the superior genial tubercles on the posterior surface of the mandible and irradiating fanlike upward and backward into the tongue; the geniohyoid muscle, originating from the inferior genial tubercles on the posterior surface of the mandible, running in a horizontal direction backward to the hyoid bone, and the mylohyoid muscle, forming the lowest level of the muscles in the floor of the mouth, extending from the mandible to the hyoid bone.

At the back of the tongue near the epiglottis are several enlarged veins.

Larynx: The section does not run exactly through the center of the larynx. Therefore, the opening of the larynx is not visible in its entire length. The epiglottis, the thyroid and the cricoid cartilage (blue) can be recognized. Below the thyroid cartilage, cross-sections through the first two tracheal cartilages are visible.

The area below the mandible and the muscles of the floor of the mouth is occupied by the submaxillary layer of fat tissue.

Below: Section through median line; nasal passage visible only in upper and anterior portion of nasal cavity owing to slight deviation of septum. A large blue mass of cartilage is seen in the nasal septum. The lower border of the septum is continuous with the hard palate. Only the soft palate is free.

The structures at the base of the skull are the same as in the section shown above. The large pharyngeal tonsil (adenoid tissue) has a deep crypt in the center.

In the ventral structures, the epiglottis and the hyoid bone are clearly visible. Directly back of the hyoid bone is the thyroid cartilage. From the hyoid bone downward runs the sternohyoid muscle. Between the latter and the anterior surface of the trachea appears the isthmus of the thyroid gland.

lying fibrous tissue of both jaws, and photographed them. (Fig. 6, *d.*) By removing the calcified caps from the underlying pulp tissue, they were able to follow the progress of calcification at different ages. The method pursued by Broomell and Fischelis showed the germs of the permanent teeth at a much earlier stage of development than they can be seen in a roentgenographic study or in the investigation of dried skulls. However, since the process of dissecting required a distortion of the germs from their original position, the position of the germs within the jaws is lost.

During the earliest stages of enamel and dentin development, these hard substances are arranged as very delicate caps overlying the horns of the dental pulp. These small caps in the early stages of calcification are difficult to demonstrate in dissecting as well as in a dry bone specimen. Particularly in the latter, it can be expected that, after decomposition of the pulp, the calcified cusps will lie loose in the bony crypt, out of their true position, and often will be lost. For this reason, it is not surprising that information about the time of calcification of the permanent teeth and the order in which

Fig. 13.—Upper jaw (age 6 months). (In these and subsequent illustrations, the tooth germs or teeth are marked as follows: deciduous teeth from central incisor to second deciduous molar, *I* to *V*; permanent teeth from central incisor to third molar, *1* to *8*.)

Left: Labiolingual section through deciduous and central incisors. The germ of the permanent central incisor is located on the lingual side of the deciduous central incisor. There is a small cap of enamel and dentin at the incisal edge of the permanent central incisor. *F*, floor of nasal cavity.

Center: Labiolingual section through the deciduous lateral incisor. There is no permanent germ in a position corresponding to the one of the permanent central incisor at the left. *F*, floor of nasal cavity; *IC*, inferior concha.

Right: Labiolingual section through deciduous and permanent cuspids. The permanent cuspid germ is placed high. The tip of this germ is calcified. *F*, floor of nasal cavity; *IC*, inferior concha.

calcification occurs has been very incomplete. This is perhaps best illustrated by the fact that the recent textbooks on dental histology by Noyes and Bödecker refer the reader to a table compiled by Legros and Magitot in 1893. This table contains many incorrect data, but, in spite of this fact, the table has for four decades been copied, without modification, by accepted authorities on histology.

If we consider the important progress of dietetics, pediatrics, orthodontia and other sciences since 1893, is it not surprising that no comprehensive investigations have been undertaken in recent years to obtain reliable information on the calcification of human teeth? As exemplary of the gross incorrectness of the table of Legros and Magitot, the following is cited. The table states that the dentin caps of *all* permanent teeth from central incisor to second bicuspid in both upper and lower jaws appear one month after birth. We have found that in reality there are differences of almost two years between formation of the dentin of the central incisor and that of the second bicuspid. And this table containing errors of one to two years is still recommended as a source of knowledge for all those interested in the problems of tooth development, nutrition, caries, prophylaxis, surgery and orthodontia.

The data published in the most recent textbook of Churchill, although we find some of the same mistakes in the table of calcification of the permanent teeth as were made by Peirce, Black and Legros and Magitot, more nearly correspond to our own than any submitted by the earlier investigators of this problem. However, Churchill puts the time of calcification of the central and lateral incisors at 2 months and of the cuspid at 4½ months, while we have been able to prove beyond doubt that the upper cuspid normally, or in the majority of instances, begins to calcify from six to eight months before

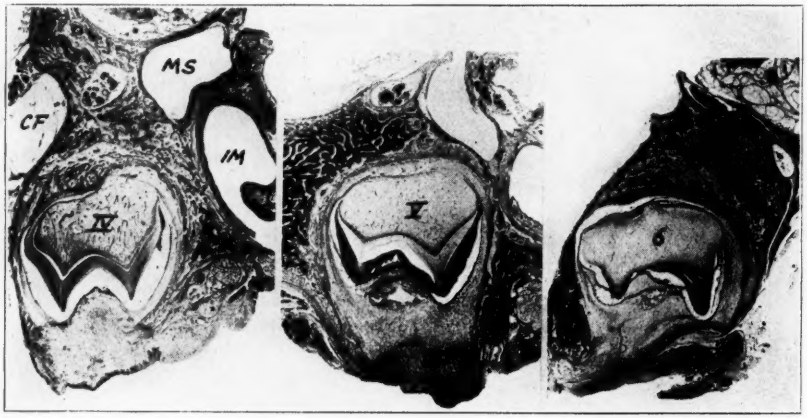

Fig. 14.—Upper jaw (age 6 months). Left: Labiolingual section through first deciduous molar. *IM,* inferior metus; *MS,* maxillary sinus; *CF,* canine fossa.
Center: Labiolingual section through second deciduous molar.
Right: Labiolingual section through first permanent molar. The two mesial cusps visible in this section are calcified but not yet united at the bottom of the occlusal fissure.

the upper lateral incisor (Figs. 13 and 15, left). The latter does not begin to calcify until about the age of 1 year. In the lower jaw, the central incisor, lateral incisor and cuspid begin to calcify at approximately the same time. Thus, we have not only found marked deviations from the heretofore accepted data, but also we have shown that there are certain distinct differences in the order of calcification of the maxillary and mandibular permanent teeth. Our findings are fully corroborated by observations made in cases of enamel hypoplasia. If it were true that the upper lateral incisor begins to calcify *before* the upper cuspid (Peirce, Legros-Magitot, Black, Bödecker, Noyes, Bunting, Churchill), how could the fact be explained that whenever the upper central incisor is affected with enamel hypoplasia at its incisal edge, the upper cuspid is involved, whereas the upper lateral incisor may be found entirely intact? (Fig. 7.)

TABLE 1.—MATERIAL AVAILABLE FOR STUDY

Age	Number of Specimens	Remarks
New-born	3	One with cleft of soft and part of hard palate
2 weeks	1	
18 days	1	Cleft of soft and hard palate
1 month	2	
5 weeks	1	
6 weeks	1	
2 months	2	
3 months	1	
5 months	1	
6 months	1	
9 months	1	
1 year	1	
1½ years	2	
2 years	1	
2½ years	1	
3 years	1	
4½ years	1	
8 years	1	Lower jaw only
11 years	1	
15 years	1	

At the end of this paper, the tables of Legros-Magitot, Peirce, Black, Brady and Churchill will be discussed and correlated with our own findings. We would like to state here that we do not consider the absolute ages of our specimens the most significant item. We are well aware that there are wide variations in the body development even of perfectly healthy children, and consequently more so of sick children who finally succumbed to various diseases. What we wish to emphasize particularly is the *order* in which calcification occurs. Regardless of whether the upper central incisor and cuspid begin to calcify at 2 months or at 6 months, the upper lateral incisor was always found in our specimens to be one-half year or more *behind* these other two in this respect, and the bicuspids from one-half to one year behind the upper lateral incisor. Far more attention will be paid in our study to this *relative order* of calcification and development than to the absolute date of the first calcification, which is naturally subject to wide individual variations.

TECHNIC EMPLOYED IN INVESTIGATION

It is evident that only a brief review of the actual work, with histologic findings, can be given in this paper.

The histologic material for the study consisted of twenty-five human jaw specimens. Table 1 shows the range of the material that was available.

The jaw specimens were removed from the bodies from one to several hours after death; thus, there were no postmortem changes of any significance. In some of the specimens, there was a slight amount of shrinkage, but not to a degree that interfered with proper interpretation of the findings. The method of removal varied. In four specimens, (2 weeks, 4 weeks, 1 month, 2 months), the entire

head and neck was removed for microscopic examination. Only the brain was discarded, the base of the skull being left intact. The relationship between the jaws and the attached hard and soft tissues was studied to ascertain all possible surgical landmarks. (Fig. 12.) In other specimens, only the maxilla and the mandible were taken from the cadaver, together with the articulation. The incisions for the removal were made through the buccal and labial vestibulum after which they were transferred to 95 per cent alcohol.

According to the clinical diagnosis, in most of the cases studied, the child died of tuberculosis or associated diseases (empyema pleurae, meningitis, etc.) Some died of severe intestinal disturbances (enteritis). One died of diphtheria, one of scarlet fever. Several of the very young children, especially the two with cleft of the hard palate (new-born, 18 days) apparently died of debility.

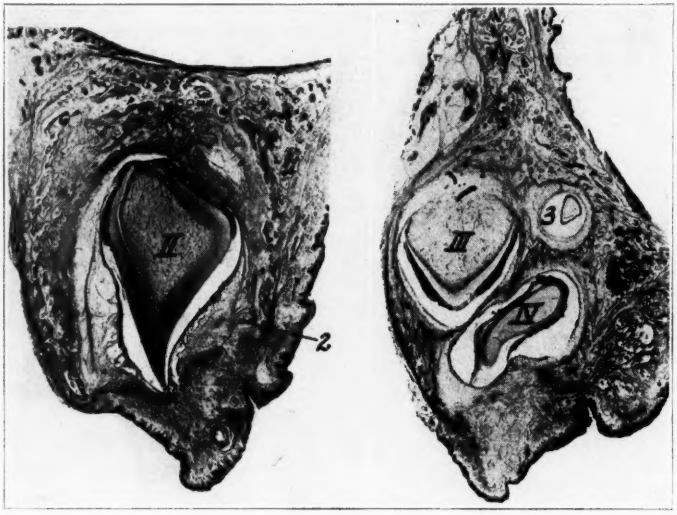

Figure 15.—Upper jaw (age 6 months). Left: Higher magnification of mesiotangential section through lateral incisor in Figure 13, center. The germ of the permanent lateral incisor (*2*) is a small epithelial bud located on the lingual side of the deciduous lateral incisor.

Right: Section through area between Figures 13, right, and 14, left. Owing to the crowded position of the tooth germs in the jaw, three different germs are visible in this one section.

and through the floor of the mouth. The upper jaw was then severed in a horizontal plane through the orbits, the mucosa and periosteum remaining intact. Immediately after removal from the cadavers, the specimens were submerged in a 10 per cent solution of formaldehyd, in which they were kept for several weeks,

After fixation, the specimens were photographed, plaster casts were made and roentgenograms were taken. These films gave very clear pictures of the germs in the jaws owing to the absence of the investing tissues. They also revealed that there was by no means a constant ratio between the degree of calci-

fication and the age of the child. This might be partly due to the fact that in some of these children, development was retarded by prolonged illness. In other cases, it might have been the result of individual variations within a physiologic range.

As to the preparation of the specimens, it was evident that the older methods of freezing or embedding in paraffin would not be satisfactory for this type of specimen. The size of the sections to be serial sections called for a more resistant embedding material. Therefore, the celloidin technic, as devised and used by Professor Gottlieb and his associates in Vienna, was decided on.

The human jaws and all adjacent bone structures, with attached soft tissues, were placed in a 5 per cent solution of nitric acid for decalcification. The approximate time necessary for complete decalcification of some of the jaws was: new-born, three days; 2 months,

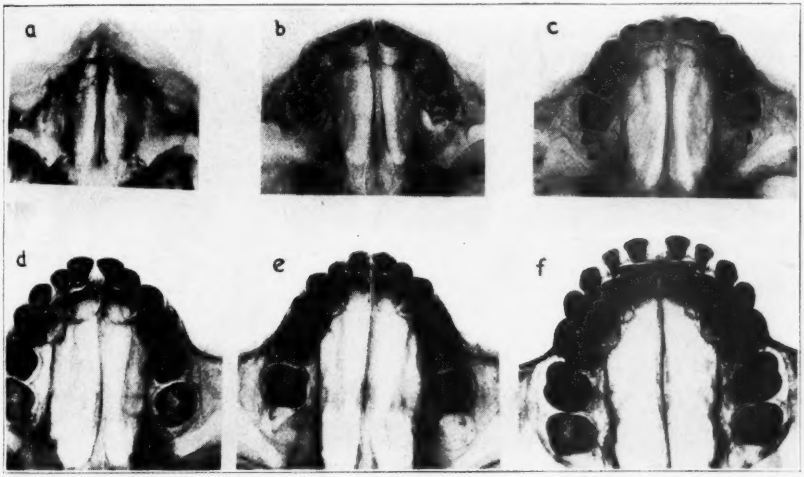

Fig. 16.—Roentgenographic study of development of teeth in upper jaw. All these films were taken in a vertical direction, before decalcification.

a (at birth), calcification of incisal edges and tips of cusps of deciduous teeth; no evidence of calcification of the first permanent molars.

b (age 5 months), advanced calcification of deciduous teeth; beginning calcification of the permanent central incisors and the first permanent molars.

c (age 9 months), appearance of incisal edges of permanent central incisors, tips of permanent cuspids and cusps of first permanent molars.

d (age 1½ years), advanced calcification of permanent central incisors, permanent cuspids and first permanent molars; beginning calcification of permanent lateral incisors.

e (age 3 years), beginning calcification of cusps of second permanent molars.

f (age 4½ years), completed formation of crowns of second permanent molars; formation of marked diastemas between deciduous anterior teeth.

cut, which varied from 2 to 8 cm., the great complexity of the structures (tooth, bone, fat, epithelium and muscle tissue in one section) and the necessity of keeping four days; 2½ years, five days, and 4½ years, ten days. After decalcification, the specimen was put into a 5 per cent solution of sodium sulphate for twenty-

four hours, after which it was washed in tap water for another twenty-four hours.

Next, the jaw was divided into segments with a razor blade or sharp knife. This segmentation was always made in whatever direction would give the maximum information. If, for instance, one-half of the maxilla was sectioned in a buccolingual direction, the other half was cut mesiodistally, or in a horizontal plane, at right angles to the axis of the tooth germs. The segments were dehydrated in alcohol of increasing percentages (50, 70 and 95 per cent, and absolute) and in alcohol-ether. They were then impregnated with celloidin, a solution of dry collodion in equal parts of absolute alcohol and ether. Increasing percentages of this solution (0.5, 1, 2, 4 and 8 per cent) were used. It took about two weeks to carry the specimens through the alcohol solutions and at least five weeks through the celloidin. Each segment was then mounted on a fiber block and was ready to be sectioned.

Serial sections were kept, thus making it impossible to overlook or lose any important structures. The sections were carried successively and directly from the microtome to the microscopic slide, 80 by 120 mm., and were covered with a very thin solution of collodion in order to keep the sections in place during staining. Harris' hematoxylin and eosin were

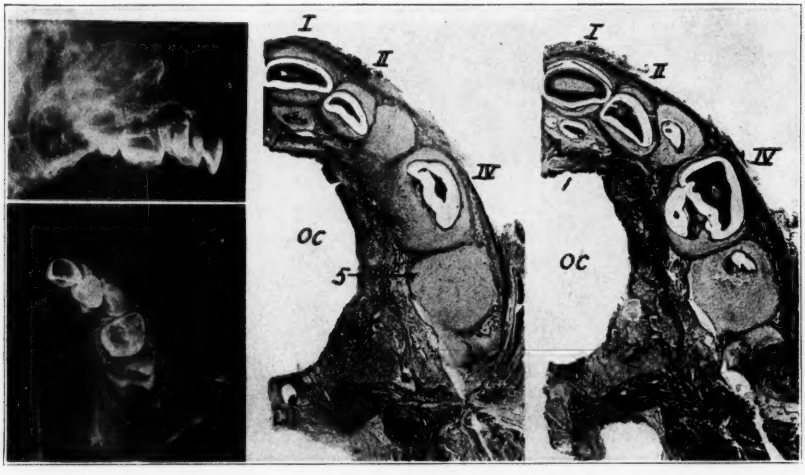

Fig. 17.—Upper jaw (age 6 months).

Left, above: Buccolingual roentgenogram of specimen before decalcification. The four separate cusps of the first permanent molar may be noted. Below: Vertical roentgenogram showing cusps of first permanent molar and calcified incisal edge of permanent central incisor linguad from deciduous central and lateral incisor.

Center: Horizontal section through plane near maxillary ridge. The tip of the deciduous central and lateral incisor and the buccal cusps of the first deciduous molar are included in this section. The germ of the second bicuspid (*5*) in the fibrous tissue below the occlusal plane of the second deciduous molar is located toward the mesial and lingual side. *OC,* oral cavity.

Right: Section slightly higher up than in Figure 17, center. The occlusal portion of all deciduous teeth is visible and, in addition, the incisal edge of the germ of the permanent central incisor. (See Fig. 13, left.) *OC,* oral cavity.

used to stain them, and after decolorization in acid alcohol and differentiation in alcohol solutions, the slides were placed in terpineol and later in xylene for further differentiation. The sections were then covered with dammar and a very thin coverglass, which does not interfere with the use of high magnifications of the microscope. The specimen was thus ready for study.

Since most of the readers are not familiar with the use of serial sections through large specimens, many of which measured 4-8 cm. in length and 3-6 cm. in width, some of the actual histologic specimens were photographed and are reproduced here in actual size. All of these specimens were prepared in the Research Department of the Chicago College of Dental Surgery, Dental Department of Loyola University, by the technician, Miss Maurine Willman.

Figure 8 is a reproduction in original size of a microscopic slide, with twenty-one labiolingual serial sections through the deciduous and permanent lower central incisors of a child of 6 months. The tip of the deciduous incisor lies near the surface of the alveolar ridge. The permanent germ is located to the lingual side of the deciduous tooth. A higher magnification of one of these sections is illustrated and described in Figure 21, left.

Fig. 18.—Upper jaw (age 6 months).

Left: Section in higher level through greatest circumference of deciduous teeth. In addition to the permanent central incisor, the tip of the permanent cuspid germ and the two mesial cusps of the first permanent molar are visible. The crowded condition of all germs is evident. *OC*, oral cavity; *NC*, nasal cavity.

Center: Section in still higher level. The germ of the permanent cuspid can be seen on the lingual side of the deciduous cuspid. (See Fig. 13, right.) *NC*, nasal cavity. *CE*, canine eminence. *CF*, canine fossa. *ZP*, zygomatic process.

Right: Section in level higher than that of most of the tooth germs. There is very marked prominence of the canine eminence (*CE*). *IF*, incisive fossa. *CF*, canine fossa. *ZP*, zygomatic process. *IC*, inferior concha.

Figure 9 shows four large celloidin sections mounted on a microscopic slide. These sections were prepared in a horizontal plane through the right half of the maxilla of a child of 6 months. Figure

17, left, shows the roentgenogram of the specimen before decalcification. A higher magnification of one of these sections is reproduced in Figure 18, left. This slide is part of a series of approximately 480 sections through the maxilla in a horizontal direction. The first sections cut across the maxillary ridge; the next through the tips of the tooth germs, and the next through the germs in their greatest diameter. The last pass through the upper poles of the germs just below the orbit. (Figs. 17, center and right, and 18.)

The upper jaw of a new-born child with a cleft through the soft palate and the posterior portion of the hard palate was cut in serial frontal sections, starting with the central incisors and running back through the cleft of the hard and soft palate. Figure 10 shows four sections through this jaw in a plane corresponding to the mesial end of the upper second deciduous molar. The cleft is plainly visible in the middle of the section. The lower margin of the vomer has lost its normal attachment to the hard palate. Therefore, it projects freely into the nasal cavity, attached only at its superior border to the base of the skull. A cross-section through the posterior part of the orbit is visible on both sides of the specimen.

Fig. 19.—Higher magnification of anterior teeth in Fig. 18, left. The germ of the permanent central incisor occupies most of the space linguad from the deciduous cuspid and the lateral incisor.

Figure 11 shows a microscopic slide of four frontal (buccolingual) sections through the entire width of the maxilla

in the region of the second deciduous molar of a child of 9 months. In each section, the germs of the second bicuspids are visible. On their buccal side, the zygomatic bone is attached to the maxilla. In the center of the sections, the lower portion of the nasal cavity is included, showing the nasal septum, inferior concha and maxillary sinus. From sections of this type, the location of the tooth germs in their relationship to the maxillary ridge, palate and floor of the nasal cavity and the maxillary sinus can be plainly seen. They also give complete information about the stage of development, calcification and root formation of each tooth. (Fig. 24, below.)

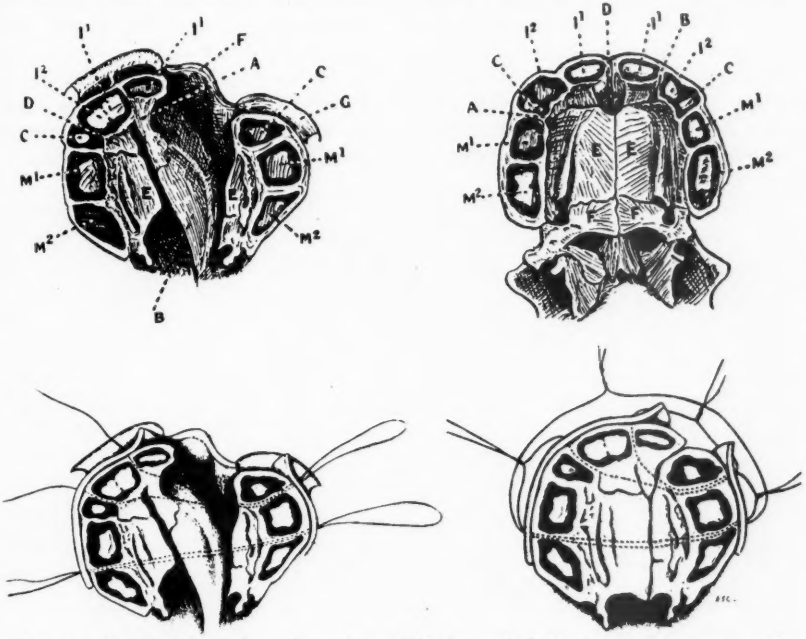

Fig. 20.—Above, right: Palate of new-born child (normal size), showing elements entering into its formation. *A*, suture between premaxilla and maxilla ending behind cuspid. *B*, the same ending behind central incisor. *C*, cuspid. *D*, vomer appearing in nasopalatine fossa. *E*, marginal part of maxillary palate. *F*, horizontal process of palate bones. (Keith.)

Above, left: Bipartitie palate. *A*, septal process of premaxilla. *B*, vomer. *C*, cuspid. *D*, premaxilla. *E*, marginal part of palate. *F*, ala of nose. *G*, maxillary, part of lip. $I,^{1}$ $I,^{2}$ incisor teeth. $M,^{1}$ $M,^{2}$ deciduous molars. (Keith.) The anterior part of a cleft palate is almost invariably a great deal more widely separated than the posterior part, an extreme example of which is seen in Professor Keith's figure above. (Brophy.)

Below, left: Extremely wide fissure closed by passing author's wire sutures between teeth and through bone. Lead plates through which the wire sutures are passed are used to prevent the wires from cutting when pressure is made to bring the edges of the cleft in contact. (Brophy, after Keith.)

Below, right: Fissure closed and normalcy established. The bones have been bent into correct position. (Brophy, after Keith.)

The necessity of keeping serial sections

for an investigation of this type cannot be overemphasized. Their study is indispensable for several reasons. In the first place, many of the important structures are so small that they cannot be seen at the time of sectioning; they can be found only after the sections have been mounted and stained. An actual example may help to make this point clear. During the first year of life, the germs of the permanent upper lateral incisor, the bicuspids and the second permanent molar measure from 100 to 300 microns (0.1 to 0.3 mm.), depending on the age. They are located in the dense cushion of fibrous connective tissue on the occlusal or lingual sides of the corresponding deciduous tooth. (Figs. 25, below and 26, above.) Therefore, the only way to find these small epithelial buds is to cut successive sections through the area under consideration and then, after the sections are mounted and stained, to examine them one by one, until the germ is located. To attempt to study the early development of the human permanent teeth by means of single sections, such as those used in other branches of dental microscopic research, would undoubtedly result in not making available all the essential facts.

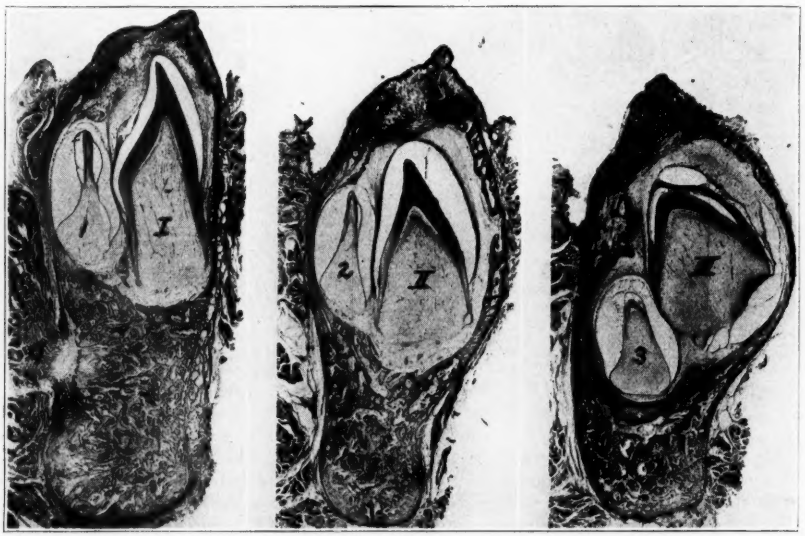

Fig. 21.—Lower jaw (age 6 months).

Left: Labiolingual section through central incisors. Calcification of the incisal edge of the permanent central incisor may be noted. G, attachment of musculus genioglossus.

Center: Labiolingual section through lateral incisors. The amount of enamel and dentin of the permanent lateral incisor is about the same as in the permanent central incisor. Compare with Figure 13, center, taken from the upper jaw of the same individual.

Right: Labiolingual section through cuspids. The formation of enamel and dentin in the permanent cuspid is somewhat less advanced than in the permanent central and lateral incisors.

Another important reason for the use of serial sections is the necessity of re-

constructing bodily a picture of the structures. The deciduous and permanent germs in the human jaw are arranged in a rather intricate and crowded manner. As histologic sections through these germs show only two dimensions, to obtain a three-dimensional picture of the jaw it is necessary to combine the findings of a great many successive sections and from this combination to draw conclusions as to the position *in situ*. This procedure is generally used in embryology, the embryologic wax models of developing organs being obtained in this way. The study of such large serial sections is equally important in the study of the tooth development, though, as a rule, the greater technical difficulties involved make the sections a rarity. Figure 12 is evidence that serial sections of such size can be prepared.

The largest tissue sections that have been prepared up to this time in our laboratory extend in an anteroposterior direction through the head of a child, 6 weeks old. These sections measure about 8 cm. in length and 6 cm. in width; they are about 35 microns thick and, owing to the perfect state of tissue fixation, all histologic details in the various tissues can be examined under high power. To our knowledge, microscopic tissue sections of this size through head and neck have never before been prepared or reported.

Fig. 22.—**Lower jaw (age 6 months).**
Left: Buccolingual section through first deciduous molar. *4*, germ of first bicuspid consisting of small epithelial bud located on the occlusal and lingual side of the first deciduous molar.
Center: Buccolingual section through second deciduous molar. *5*, germ of second bicuspid branching off on lingual side of dental lamina. *MC*, mandibular canal.
Right: Buccolingual section through mesial cusps of first permanent molar. Each cusp consists of a separate cap of enamel and dentin. *MC*, mandibular canal.

DESCRIPTION OF SOME OF THE SPECIMENS AND OF THE FINDINGS OBTAINED

Figure 12 is a colored engraving, obtained by reproduction of two of these large tissue sections by color photography. The figure shown is 1.6 times the original size of the specimen. The section above runs in a sagittal plane through the nostril and the upper central incisor. In the up-

per portion of the section, the nose is visible, and the nasal cartilage may be recognized by its color, blue. Farther back the base of the skull forms the root of the nasal cavity and of the pharynx. Downward, the base of the skull is continued into the spinal column.

The palate forms the separation between the nasal and oral cavity. The anterior portion of the hard palate contains the germ of the deciduous central incisor and, lingually from it, the germ of the permanent central incisor. (See also Fig. 13, left.) In the soft palate, the zone of muscle tissue (nasal side) and of gland tissue (oral side) may be differentiated. In the mandible, there is only a tangential section of the deciduous central

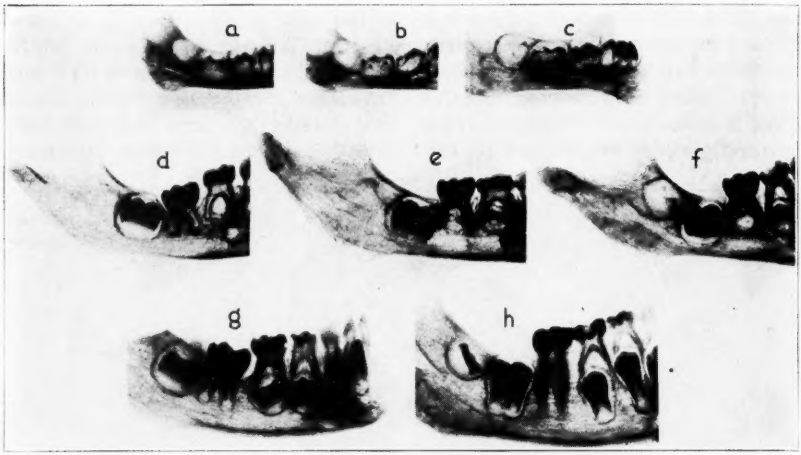

Fig. 23.—Roentgenographic study of development of teeth in posterior portion of lower jaw (all films taken in a horizontal direction before decalcification).

a **(at birth), calcification of cusps of deciduous molars and of tip of deciduous cuspid; no calcification of first permanent molar.**

b **(age 2 months), beginning calcification of mesial cusps of first permanent molar.**

c **(age 3 months), appearance of separate small calcified caps at cusps of the first permanent molar. The cusps of the second deciduous molar are still separated. Those of the first deciduous molar have already united at the fissures.**

d **(age 1 year), extensive calcification of crown of first permanent molar. The roots of the deciduous molar are forming and the first deciduous molar has erupted.**

e **(age 2 years), fully formed crown of first permanent molar. The first and second deciduous molars have erupted. The calcified cap of the first bicuspid appears between the roots of the first deciduous molar. Behind the first permanent molar, formation of a bony crypt for the second permanent molar is evident.**

f **(age 2½ years), evidence of calcification of four cusps of second permanent molar and tip of second bicuspid.**

g **(age 4½ years), fully formed crowns of permanent central and lateral incisors, permanent cuspid and first bicuspid, with crown of second permanent molar and second bicuspid still forming.**

h **(age 11 years), resorption of roots of deciduous cuspid and of deciduous molars by permanent successors, beginning formation of bifurcation of second permanent molar. The fully formed occlusal portion of the third molar may be noted. (See also Fig. 31.)**

incisor, owing to the fact that, at the time of death and tissue fixation, the mandible deviated slightly from the median line, and, consequently, a central section through the upper central incisor does not also pass through the central part of the corresponding lower tooth.

Special attention should be called to the position of the tongue. The back of the tongue lies far above the plane of the mandibular ridge and, when the mouth is closed, the tongue occupies the entire space below the curvature of the palatine vault. Various groups of muscles may be seen in the tongue: the mylohyoid muscle, forming the lowermost layer and consisting of a thin plate of muscle fibers attached to the hyoid bone; next above, the geniohyoid muscle, a strong bundle running from the posterior plane of the mandible to the hyoid bone, and, above this, the genioglossus muscle originating from the superior genial tubercles and irradiating fanlike into the tongue.

A section through the same specimen, parallel to the one shown in Figure 12, above, but directly in the median line of the head, is reproduced in Figure 12, below. In the upper part of the section, the nasal septum can be recognized by its color, blue (hyaline cartilage). On its posterior end, the septum is attached to the body of the sphenoid bone. On the upper surface of the sphenoid is a cross-

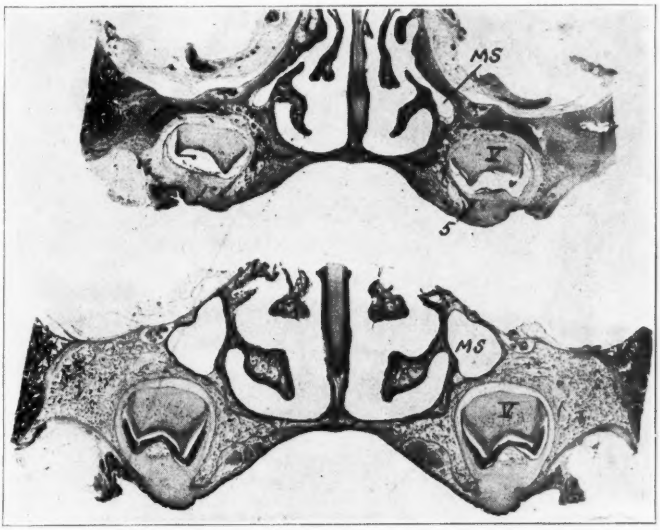

Fig. 24.—Frontal sections through entire width of maxilla in region of second deciduous molars.

Above, at birth, the cusps of the second deciduous molar have just begun to calcify. At *5*, the epithelial bud for the second bicuspid is visible. The maxillary sinus (*MS*) consists of a narrow space opening into the middle meatus.

Below, at the age of 9 months, the formation of the enamel is nearly completed. The increase in height of the bone around and above the tooth germ and the remarkable increase in size of the maxillary sinus (*MS*) are evident.

section through the optic chiasm and through the hypophysis. The spheno-occipital synchondrosis back of the sphenoid can again be easily recognized by the color (blue) of the hyaline cartilage. Below this point, the basal part of the occipital bone may be seen. The atlas, the epistropheus and the first three cervical vertebrae are included in the section.

The base of the vomer is attached to the hard palate. The soft palate and uvula extend freely backward from the posterior nasal spine. The floor of the pharynx above the uvula is occupied by a large organ that stained dark purple. This structure is the pharyngeal tonsil. Its surface is uneven and divided into individual lobes between which deep crypts

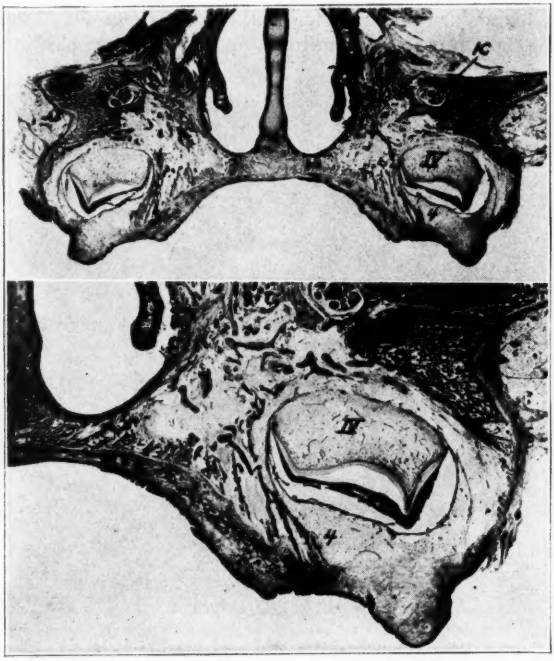

Fig. 25.—Above: Frontal section through maxilla of new-born child, in region of first deciduous molar. *IV*, first deciduous molar. *4*, position of germ of first bicuspid. *IC*, infraorbital canal. Figures 25-30 show different degrees of development and changing positions of the upper first bicuspid between birth and the age of 15 (buccolingual sections).

Below: Higher magnification of Figure 25, above. The germ of the first bicuspid (*4*) consists of a small epithelial bud lying in the fibrous connective tissue that extends between the lingual cusps of the deciduous molar and the surface of the maxillary ridge.

These bones likewise consist, for the most part, of hyaline cartilage. Each one contains a nucleus of calcification and bone formation, distinguished by its color, dark purple.

extend into the substance of the tonsil. The location of the pharyngeal tonsil at the point of passage from the nasal cavity into the pharynx explains readily why children with a pathologic overgrowth

of this lympathic tissue (adenoids) have difficulty in breathing through the nose.

From the pharyngeal tonsil, the constrictor muscles of the pharynx extend down toward the esophagus. At the anterior wall of the esophagus, the uppermost three cartilaginous rings of the trachea are visible. Above them, we find the cricoid and thyroid cartilage and, still higher, near the base of the tongue, the epiglottis. In front of the larynx, the upper pole of the thyroid gland can be seen. A small muscle attached to the lower margin of the hyoid bone and passing in front of the thyroid cartilage and the thyroid gland can be identified as the sternohyoid muscle.

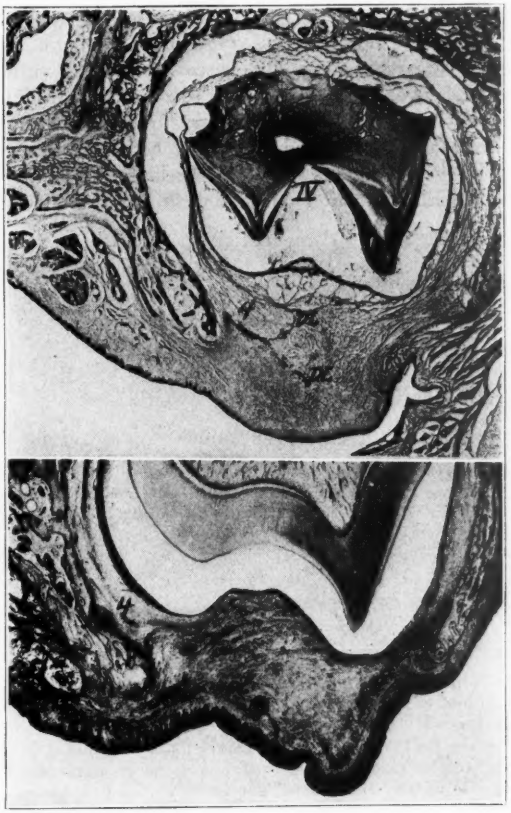

Fig. 26.—Above: Section made at the age of 6 weeks. The bicuspid germ (*4*) branches off from the lingual side of the dental lamina (*DL*). The cusps of the first deciduous molar are just ready to become united at the occlusal fissure.

Below: Section made at age of 9 months. The germ of the first bicuspid (*4*) lies on the inner side of the lingual crest of the alveolar bone.

This description of the anatomic structures found in sagittal sections through a child's head may appear to be not strictly appropriate to the problem of tooth development. Still, since these large sections give an unusually clear picture of the tooth positions, it seemed that a brief review of the various structures might be advantageous.

A description of some of the histologic findings concerning the development and position of the teeth at different periods of life follows. In the discussion of the anatomy of the maxilla, attention will also be called to the importance to surgical procedure of some of the findings in and about the jaws.

The surgeon working on the maxilla of a child a few months old has only a few definite landmarks to guide him in his work. The deciduous and permanent tooth germs are inside the jaw, and since there was not enough reliable information on this subject available, the diagrams in the older publications and textbooks on surgery are far from accurate. (Compare Figures 4 and 5 with the specimens in Figure 24.) Therefore, it is necessary that all surgeons be cognizant of the normal structure of the human jaws in childhood if grave end-results are to be obviated.

Technical limitations make it impossible to show even one or two sections of each one of the nearly fifty mandibles and maxillae from twenty-five heads that were sectioned in the course of this investigation. Therefore, rather than reproduce too great a variety, sections from only a few jaws will be reproduced, but

Fig. 27.—Left: Section made at age of 1½ years. The bicuspid germ has begun to differentiate into pulp and enamel organ. At this time, it is located near the mesial end of the corresponding deciduous molar between the latter and the deciduous cuspid. The permanent cuspid germ lies above the bicuspid germ. *4*, germ of first bicuspid. *IV*, mesial end of crown and of buccomesial root of first deciduous molar. *3*, germ of permanent cuspid.

Right: Section made at age of 2 years. The germ of the first bicuspid has differentiated further and shows two distinct cusps. At the buccal cusp, enamel and dentin have begun to form. The bicuspid is lying on the lingual side of the deciduous molar. A strand of epithelial cells (*E*) connect the germ with the oral mucosa and indicate the path that the germ followed on its way from its more occlusal position up into the lingual bone.

these will be so selected as to give the maximum information as to position and development of each deciduous and permanent tooth at the given age. Then the reader will be able to see how, by combining information gained from all such specimens, a continuous picture of the growth and position of each tooth from birth on can be obtained.

Figures 13-14 show labiolingual and buccolingual sections through the maxilla of a child 6 months of age. The study of merely these six sections brings up a variety of problems and questions. In Figure 13, left, the deciduous and permanent central incisors are visible. The crown of the deciduous incisor is already formed, and, in addition, a part of the root has developed. The permanent central incisor is located on the lingual side of the deciduous tooth, near the floor of the nasal cavity. The incisal edge is already calcified, a small amount of both enamel and dentin being present. The great mesiodistal width of this germ can be seen in horizontal sections through the same specimen. (Figs. 18, left, and 19.)

Figure 13, center, shows a labiolingual section through the lateral incisor region. The deciduous lateral incisor is about as far advanced in development as is the deciduous central incisor. The most remarkable thing in this section is the apparent absence of a permanent lateral incisor germ in a position similar to that of the permanent central incisor germ in Figure 13, left. An examination of this specimen under high power reveals that the permanent lateral incisor germ, at this period of life, is merely a small

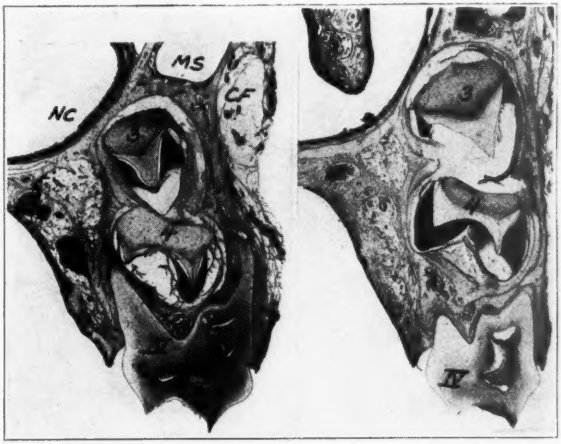

Fig. 28.—Left: Section made at age of 2½ years. Both cusps of the first deciduous molar show enamel and dentin and are about to become united in the fissure. The germ is located between the spreading roots of the first deciduous molar. The germ of the permanent cuspid lies above the germ of the first deciduous molar, in the area between the floor of the nasal cavity (*NC*), the mesial end of the maxillary sinus (*MS*) and the canine fossa (*CF*).

Right: Section made at age of 3 years; advanced formation of enamel of first bicuspid. The relative position of the first deciduous molar, first bicuspid and permanent cuspid is the same as in Figure 28, left; all three teeth lie in the same horizontal plane running through the mesial part of the crown of the first deciduous molar.

epithelial bud without further differentiation, located on the lingual side of the deciduous lateral incisor. (Fig. 15, left, *2.)* This striking difference between the degree of development of the central and the lateral incisors will be discussed more in detail in the latter part of this paper.

In Figure 13, right, a labiolingual section through the cuspid region is reproduced. The development of the deciduous cuspid is less advanced than that of the deciduous incisors. Its root has not yet begun to form. The germ of the permanent cuspid lies in a slightly higher level than the floor of the nasal cavity. Apparently, the cuspid germ has already begun to assume its later position above the other permanent germs, high up in the angle between nose, maxillary sinus and orbit. (Fig. 28.) The tip of the permanent cuspid is calcified. There is somewhat less enamel and dentin present than in the permanent central incisor at the same age.

The first deciduous molar (Fig. 14, left) shows a fully formed crown and beginning formation of the roots. In the second deciduous molar, the crown is just about completely formed, but root formation has not yet begun. (Fig. 14, center.) There is no evidence of the bicuspid germ. As will be shown later, these germs are, at this period of life, small epithelial buds located on the occlusal side of the deciduous molars and to the lingual aspect of the center of the decidu-

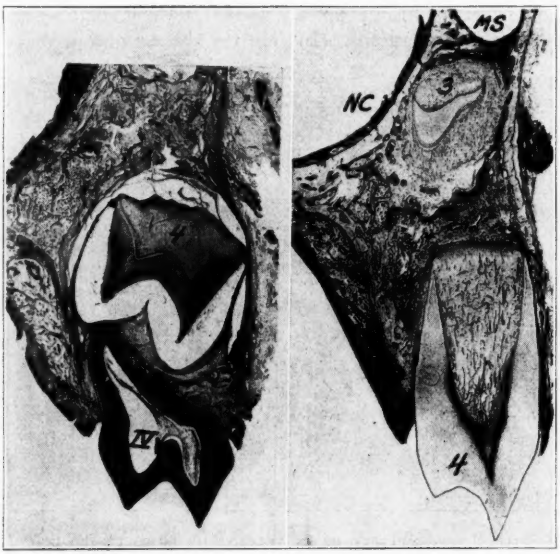

Fig. 29.—Left: Section made at age of 4½ years. The crown of the bicuspid is fully formed. There is beginning resorption of the roots of the first deciduous molar.

Right: Section made at age of 11 years. The first bicuspid is erupted and has reached the occlusal line. The root end is wide open. *3,* root end of permanent cuspid. The cuspid occupies a tipped position, its crown being located between the lateral incisor and the first bicuspid, its root end directly above the first bicuspid. *NC,* nasal cavity. ***MS,*** maxillary sinus.

ous germs that they are ultimately to replace. (Figs. 25-26.)

The upper first permanent molar (Fig. 14, right) shows enamel and dentin formation in all four cusps. The cusps are not yet united in the occlusal fissures, and each cusp develops separately. This is an important fact with reference to the incorrect statements found in the literature concerning the time of calcification

Fig. 30.—Section made at age of 15 years. The first bicuspid is fully developed and in normal occlusion. The topographic relationship between tooth and surrounding structures of the jaw is to be noted. *NC*, floor of nasal cavity. *P*, palatal tissue. *B*, very thin buccal bone plate.

of the first permanent molar. Whereas most dental authorities state that the crown of this tooth has attained a considerable degree of calcification at birth, our investigations have shown that this is not correct. (Figs. 16, *a*, and 23, *a*.) That calcification of the first permanent molar begins at birth or shortly thereafter was recently brought out in a roentgenographic and chemical study of the calcification of the teeth by Hess, Lewis and Roman. These authors, who found no calcification present in the first permanent molar at birth, state that calcification of this molar is a postnatal and not a prenatal phenomenon. This is in accord with our own findings.

Brady, in a chart published in 1924, presents a diagram of the first permanent molar at birth showing all cusps united on the occlusal surface. Our actual specimens show that not only is there no calcification at all in the first permanent molar at birth, but that even at the age of 6 months, the four cusps have not yet become united.

Figures 13-14 show strictly central sections through the teeth. Such sections can be misleading, since they may give the impression that there are definite spaces between the individual teeth, which is by no means correct. The serial sections from the areas between the teeth show that these teeth are in a very crowded condition in the maxilla, and that there is a considerable overlapping of the various deciduous and permanent tooth germs. Figure 15, right, shows a section lying *between* the sections illustrated in Figures 13, right, and 14, left. Here we find, in one area, the distal surfaces of the deciduous and permanent cuspid and the mesial surface of the first deciduous molar. Figure 18, left and center, presents even a better idea of the overlapping of these germs within the maxilla.

Figure 16 shows a series of roentgenograms of some of the jaw specimens before decalcification. Figure 16, *a*, presents the maxillae at birth. No trace

of a first permanent molar is visible. The cusps of the deciduous molars, which are not yet united, appear as separate centers of calcification. Figure 16, *b*, is of a corresponding specimen at the age of 5 months. At this age, the four separate cusps of the first permanent molar can be distinguished as small centers of calcification. The calcified incisal edge of the permanent central incisor appears as a faint line linguad from the deciduous central incisor. (See also Fig. 17, left, below.)

At the age of 9 months (Fig. 16, *c*), the calcification of the crowns of all deciduous teeth seems to be completed. The cusps of the first permanent molar have become united. The permanent central incisor is distinctly visible on the lingual side of the deciduous central and lateral incisors.

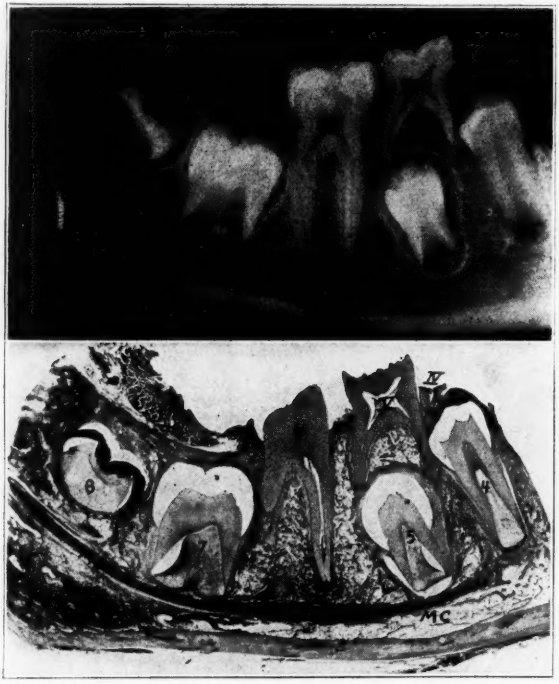

Fig. 31. Above: Roentgenogram of posterior portion of jaw at age of 11 years. The first bicuspid is almost erupted. The second bicuspid has begun to resorb the roots of the overlying deciduous molar. The three permanent molars present various stages of development.

Below: Mesiodistal section through specimen, roentgenogram of which is shown above. The mandibular canal (*MC*) is just below the open root ends of the second bicuspid and the second permanent molar. In the third molar, the enamel is still developing. In the second molar, the enamel formation is finished and about one half of the roots formed. The first permanent molar is fully developed and in occlusion. Of the second and first bicuspid, one half and two thirds of the roots are formed, respectively.

At the age of 1½ years (Fig. 16, *d*),

the calcification of the crown of the first permanent molar has increased considerably. The same is true of the crown of the permanent central incisors. The tip of the crown of the permanent cuspid is visible; whereas, the permanent lateral incisor is not yet sufficiently calcified to be clearly visible in the roentgenogram.

At 3 years of age (Fig. 16, *e*), the permanent central and lateral incisors can be plainly distinguished. The crown of the first permanent molar is fully calcified. Posterior to it, the four separate cusps of the second permanent molar can be seen. At the age of 4½ years (Fig. 16, *f*), the crown of the second permanent molar is fully formed. The germs of the bicuspids and the cuspids are, in this position, projected into the crowns of the corresponding deciduous teeth. There are wide spaces between the deciduous anterior teeth at this age.

Special attention should be called to the position of the zygomatic process of the maxilla. From a comparison of the roentgenograms in Figure 16, it can be seen that the maxilla develops forward from the attachment of the zygomatic bone as well as backward. The distance between the deciduous central incisors and the anterior attachment of the zygomatic bone increases steadily, and so does the distance between the maxillary tuberosity and the posterior attachment of the zygoma.

As mentioned in the early part of this paper, the original incentive for this study was the desire to know definitely what

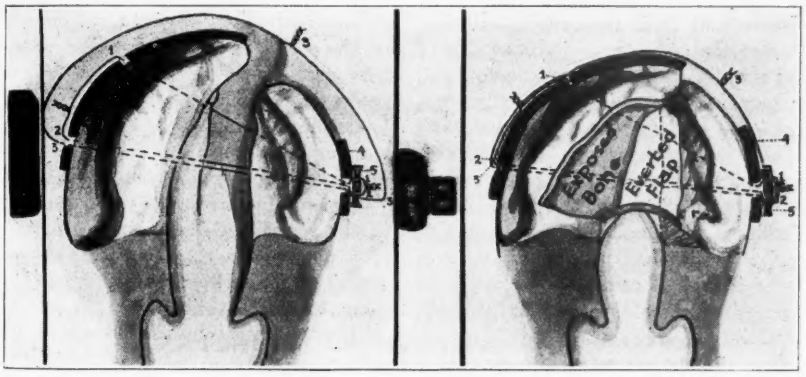

Fig. 32.—Left: *1*, anterior wire; *2* and *3*, posterior wires; *4*, lead plates; *5*, uranoplastic button.

Right: *1*, anterior wire; *2* and *3*, posterior wires; *4*, lead plates; *5*, uranoplastic button; *6*, silk sutures. (Indications and contraindications for direct application of force through the medium of silver wires and lead plates, as well as recommendation of the universal adoption of the everted flap for the closure of the cleft extending through the anterior part of the hard palate in early infancy, as set forth by one of the authors [W.H.G.L.], may be found in the Transactions of the Eighth International Dental Congress, Paris, France, August, 1931.)

structures may be encountered by any instrument or suture that is passed through the maxilla in cleft palate surgery. These structures were shown in Figures 13-15, as they appear in buccolingual sections through the jaw. There follows a study of a series of horizontal sections through the same jaw specimen, since the com-

bination of microscopic sections in more than one plane gives more complete information than sections in merely one direction. In horizontal sections, certain clinical landmarks on the buccal and labial aspect of the jaw may be recognized. These clinical landmarks are: (1) the prominence of the bone covering the germ of the deciduous cuspid (canine eminence) and (2) the zygomatic process of the maxilla and the attachment of the zygomatic bone to the maxilla.

In horizontal sections through the maxilla of a child of 6 months, the general arrangement of the deciduous and some of the permanent germs will be shown, and their topographic relationship to the structures on the outside of the maxilla (incisive fossa, canine fossa, zygomatic process) indicated.

Figure 17, left, shows roentgenograms of this 6-months specimen. The roentgenogram above was taken in a horizontal direction through the halved maxilla. All deciduous teeth and the first permanent molar are visible. Of the latter, four separate centers of calcification are visible, corresponding to the four cusps of the molar. (Fig. 14, right.) In Figure 17, left, the same specimen is visible in a roentgenogram taken vertically, parallel to the long axis of the teeth. This roentgenogram clearly shows the crowded arrangement of the deciduous germs in the jaw. Each tooth overlaps its neighbor on its buccal or lingual side. The four cusps of the first permanent molar still appear separated, pointing distally rather than occlusally. Special attention should be called to the distinct eminence of the outer bone plate of the maxilla overlying the cuspid germs and to the attachment of the zygoma. The anterior line of the zygoma joins the maxillary bone in a frontal plane running through the posterior end of the first deciduous molar. The posterior line of the zygoma is located in a line running through the germ of the first permanent molar. The overlapping of certain deciduous teeth in the maxilla, the position of the permanent central incisor in relation to the deciduous central and lateral incisors, the lack of calcification of the permanent lateral incisor, the relation of the bicuspid germs to the deciduous molars, as well as the line of attachment of the zygoma to the maxilla in the early months of life, constitute some of the outstanding findings having relation to the surgical treatment of a complete congenital cleft by means of either the direct or the indirect application of force, provided the closure of the palate is to be completed sometime previous to the third year.

On the lingual side of the central and lateral deciduous incisors, a fine dark line running in a mesiodistal direction is visible in the roentgenogram. This small radiopaque mass is the earliest portion of the permanent central incisor to calcify; namely, a fine ledge of enamel and dentin at the incisal edge of this tooth. (Fig. 13, left.)

The specimen from which these roentgenograms were taken was sectioned into approximately 480 horizontal serial sections, beginning at the maxillary ridge and ending below the orbit. Five of these sections are reproduced in Figures 17, center and right, and Figure 18. Figure 17, center, shows a section rather close to the alveolar ridge. The only teeth in this level are the deciduous central and lateral incisors and the first deciduous molar. In a slightly higher level (Fig. 17, right), the incisal portion of the permanent central incisor is visible. If the sections run through a still higher plane, they include all deciduous teeth as well as the germ of the permanent central incisor and of the first permanent

molar. (Fig. 18, left.) The position of the germ of the permanent central incisor is very remarkable. It lies directly linguad from the deciduous central and lateral incisors extending in its mesiodistal diameter over almost the entire width of these two deciduous teeth. In comparing this topographic relationship to the drawings in Figure 20, it becomes evident that any wire or needle carrying any type of suture material passed *between* the deciduous central and lateral incisors at the general level at which they have usually been placed would frequently injure the germ of the permanent central incisor and cause an uncalled for malalinement, and, on occasion, complete destruction of this tooth; but, with greater frequency, major displacement or destruction of the epithelial bud of the permanent lateral incisor would be the result.

A section in a somewhat higher level shows the contour of the outer plate of the maxilla with its typical configuration. (Fig. 18, center.) Over the roots of the incisors, the bone is slightly depressed (incisive fossa). Over the cuspid the bone is markedly prominent (canine eminence). Distad from the cuspid, there is again a depression in the bone (canine fossa). Its position corresponds approximately to that of the anterior two-thirds of the first deciduous molar. On the buccal side, opposite the distal third of the first deciduous molar and entirely overlying the second deciduous molar, as well as a few lines along the anterior bone opposite the germ of the first permanent molar, the zygomatic process of the maxilla, in its major part, is attached to the buccal bone plate between the second and sixth month of life. The second deciduous molar and part of the first permanent molar are lying directly beneath the attachment of the zygomatic process of the maxilla and the zygomatic bone. The distal surface of the maxilla consists of a very delicate bone plate covering the first permanent molar. The fat tissue of the pterygopalatine fossa occupies the space between the posterior plane of the maxilla and the anterior plane of the major ala of the pterygoid.

Attention should be called to the arrangement of all tooth germs at this age. There is not enough space present between the deciduous germs to pass a wire from the outside of the maxilla between the germs, nor would it be possible, in doing so, to avoid injury to the permanent germs (central incisor and cuspid) lying on the lingual side of the deciduous germs.

If sections are cut through the maxilla in a higher level, closer to the floor of the orbit, it is found that the upper poles of the germs are encountered in the same order as when they are approached from the occlusal side. The incisors and the first molar, the first deciduous teeth to erupt, occupy a position farthest toward the occlusal surface. Thus, these germs lie below the plane of a section running through the cuspid eminence at its height. (Fig. 18, right.) In this plane, the only dental structures visible are the upper ends of the deciduous and permanent cuspid germs, the distal portion of the second deciduous molar and the distal cusps of the first permanent molar. It is therefore possible to pass wires through the bone in this level without interfering with any germs. The two places that allow such an operation are (1) above the lateral incisor in an area anterior to the cuspid eminence (incisive fossa) and (2) distad from the cuspid eminence, between the latter and the zygomatic process (canine fossa) and just above the first deciduous molar.

From the foregoing statements, the conclusion should not be reached that

various surgeons have not, on occasion, been able to pass wires and other suture material successfully through the infantile jaw without injury to the tooth germs (Fig. 2, *b*); but the fact is pointed out that this has not been done uniformly because no authoritative information has been submitted in the form of landmarks to guide the operator, until this study was made. The surgical technic in the direct application of force that was formulated by one of us (W. H. G. L.) subsequent to this study has been previously published in the Transactions of the Eighth International Dental Congress. (Fig. 32.)

Before continuing with the description of our own histologic findings, let us consider for a moment the old ideas concerning the topography of the human jaws in infancy. Figure 20, above, shows two drawings published by Brophy after Sir Arthur Keith. They represent specimens of the infantile maxilla showing the deciduous tooth germs. Each tooth is drawn as being located in a definite bony crypt, while in reality there is hardly any separation at all between the individual teeth. Brophy used Keith's drawing to illustrate his technic of direct application of force in cleft palate surgery. (Fig. 20, below.) He drew the wires as passing through the bone and the bony septums between the deciduous teeth. From our specimens, we now know that such a procedure would be impossible. Not only is it not possible for a wire to be passed between these deciduous teeth at the indicated level, but even were it passed as indicated in Figure 20, below, between the central deciduous incisors, it would invariably cause injury or displacement of the germs of the permanent central incisors. (Fig. 19.)

We shall now consider the location and development of the deciduous and permanent tooth germ in the mandible of a child of 6 months. For this purpose, six labiolingual and buccolingual sections will be illustrated. Figure 21, left, shows a labiolingual section through the area of the lower central incisor. The crown of the deciduous central incisor is fully formed. The portion of the root present is slightly longer than the one of the corresponding upper incisor. (Fig. 13, left.) As a rule, we have found that the lower teeth are somewhat ahead of the corresponding upper teeth in their development. It is well known that the lower teeth also usually erupt earlier than the upper ones. The permanent lower central incisor lies on the lingual side of the deciduous predecessor. On its incisal edge, enamel and dentin have already begun to form.

The lower deciduous lateral incisor (Fig. 21, center) shows a development similar to that of the deciduous central incisor. The germ of the permanent lateral incisor is almost as far developed as the germ of the permanent central incisor. This remarkable difference between the upper and the lower lateral incisor can readily be seen by comparing Figure 13, center, with Figure 21, center. It is also clearly confirmed in all cases of enamel hypoplasia. (Table 3.)

The germ of the permanent lower cuspid lies slightly below the germ of the deciduous cuspid. Its calcification is slightly less advanced than that of the lower permanent central and lateral incisor, corresponding to the calcification of the upper permanent cuspid. (Fig. 13, right.)

The lower first deciduous molar (Fig. 22, left) shows a completely formed crown. The crown of the second deciduous molar (Fig. 22, center) is still in the process of calcification. The germs of both lower bicuspids are small epithelial

buds lying on the occlusal and to the lingual side of the center of the deciduous crowns. (Fig. 22, left, *4*, and center, *5*.)

The lower first permanent molar (Fig. 22, right) shows formation of enamel and dentin in each one of its four separate cusps. The cusps are just about ready to become united at the occlusal fissures.

The growth of the mandible and the development of the teeth can be studied in a series of roentgenograms taken from specimens before decalcification. (Fig. 23.) Figure 23, *a*, shows the mandible at the time of birth. The crowns of the deciduous molars still consist of separated cusps. Of the first molar, only the bony crypt is visible. No evidence of calcification whatsoever can be seen. The importance of this observation, which disproves the old and generally accepted saying of a "prenatal" calcification of this tooth, has already been emphasized.

At the age of 2 months (Fig. 23, *b*), the first evidence of calcification of the first permanent molar is visible in the form of two very delicate centers of calcification in both mesial cusps. At 3 months (Fig. 23, *c*), these calcified cusps are more distinct. At 1 year of age (Fig. 23, *d*), the crown of the first permanent molar is well formed and calcified. At about 2 years (Fig. 23, *e*), there appears a small bony crypt on the distal side of the first permanent molar. This crypt contains the germ of the second permanent molar, which still consists merely of soft tissue without calcification. At this age, the tip of the lower first bicuspid becomes visible in the roentgenogram. At 2½ years (Fig. 23, *f*), the four cusps of the second permanent molar have begun to calcify. The calcified portion of the crown of the first bicuspid is clearly visible, while the second bicuspid is just beginning to calcify and to become visible roentgenographically. Figure 23, *g*, shows the mandible at the age of 4½ years. The crowns of the second permanent molars and of the bicuspids are fully developed. At the age of 11 years, finally, the third molar appears distad from the second molar. (Fig. 23, *h*.) At this time, the roots of the deciduous cuspids and of the deciduous molars are markedly resorbed.

These roentgenograms make it possible to study the growth and structural changes in the jaws with advancing age. Another way to study these changes consists in comparing sections through corresponding areas of the jaws of children of different ages. Such sections have the great advantage of avoiding any superimposition of structures, which is unavoidable in a similar roentgenographic study. By preparing, for instance, frontal sections through the entire width of the upper jaw at different ages and comparing these sections in photomicrographs taken at the same magnification, it is possible to determine how the jaws become wider and higher, how the teeth develop and grow, and how they change their positions relatively to the surrounding structures, how the maxillary sinus develops, and many other related problems. There are, of course, some individual variations among various children from whom these specimens were obtained; but it has been our observation that, at least during the first and second years, the arrangement and structure of the tooth germs and jaws is rather constant and uniform. The individual variations do not develop until in later years, when outer influences and inner tendencies (inherited size and shape of the jaws, etc.) become more marked and influential.

Figure 24 affords a comparison between corresponding sections at different

ages. In Figure 24, above, a frontal section through the area of the second deciduous molar of a child at birth is reproduced. The germs are lying close to the floor of the orbit. The entire jaw is very low and relatively wide. The cusps of the second deciduous molars are calcified but not yet united. (See also Fig. 16, *a.*) In this section, the maxillary sinus is clearly visible, appearing as a narrow pouch opening into the middle meatus. Figure 24, below, shows a corresponding section at the age of 9 months photographed with the same magnification as Figure 24, above. The jaw has become considerably wider and higher. The calcification of the crown of the second deciduous molar is nearly completed. The distance between this germ and the floor of the orbit has become considerably greater. Very remarkable is the increase in size of the maxillary sinus. While at birth it is hardly more than a capillary cleft lined with nasal mucosa, at the age of 9 months it has reached a considerable size. Here, too, the possibility of individual variation has to be considered. The size of the antrum of Highmore varies much more among various people than does the shape or size of the jaw or of the teeth.

CHANGES IN THE RELATIVE POSITION OF THE DECIDUOUS AND PERMANENT GERMS AT VARIOUS AGES

It is well known that all permanent germs bud from the dental lamina that connects the deciduous germ with the oral epithelium. This development of the permanent tooth takes place on the lingual side of the dental lamina. Since the dental lamina extends in a more or less straight line from the oral epithelium to the deciduous germ, the permanent germ in its earliest stages of development will necessarily be found *occlusally from* the deciduous germ and somewhat toward the *lingual* side of it. This position is known from previous studies of the embryology of the teeth.

Furthermore, it is a well-known fact that from an age of about 4 years, all permanent germs lie *above* the deciduous predecessors in the maxilla and *below* them in the mandible. (Fig. 23, *g.*) The question which to our knowledge has so far not yet been investigated is this: How do the permanent germs get from their original position occlusally from the deciduous teeth into their final position, between and above the roots of the deciduous teeth? This change in position will be demonstrated by the use of ten buccolingual sections through the upper first bicuspid at various ages. As identical changes are also found in all other permanent teeth that have deciduous predecessors, it can be stated that all permanent germs from the central incisor to the second bicuspid are first located in the fibrous connective tissue below the incisal edge or below the occlusal surface of the corresponding deciduous teeth. Later on, their position shifts more and more toward the lingual side, until the permanent germ is found embedded in the bone on the lingual side of the crown of the deciduous tooth. Then, as the latter moves occlusally, the permanent germs pass on above the roots of the deciduous incisors and cuspids or between the diverging roots of the deciduous molars, so that finally they are found directly above the deciduous teeth.

This change in the relative positions of the deciduous and permanent teeth is the result of a combined action of bone growth and of active movement of the deciduous teeth. During the gradual increase in the height of the alveolar process, the permanent germ that originally was lying in the fibrous tissue of the

ridge is surrounded by the growing bone. At the same time, the deciduous tooth moves occlusally, thus leaving the permanent germ behind, until the latter has assumed its final position above or between the deciduous roots.

Figures 25-30 illustrate the "migration" of the germ of the upper first bicuspid between birth and the age of 15 years. This germ is, at birth, located definitely on the occlusal side of the first deciduous molar. At 4 years, it is above and between the roots of the first deciduous molar. How it moves from one position to the other will be shown. All permanent teeth from central incisor to second bicuspid in both upper and lower jaws undergo a similar change in position. However, since there are great differences in degree of development among the permanent teeth, it is evident that those germs that develop earlier will sooner assume the various positions as shown in Figures 25-30. Those germs that develop relatively late will run through all these various phases at a later period of life. Since the development of the germs of the central incisors and of the cuspids begins before birth, these germs at birth are already found well up on the lingual side of the deciduous predecessor. Therefore, the latter teeth do not change their position during the postnatal period of development to the same extent as do the bicuspid germs, the formation of which begins considerably later.

At the time of birth, the germs of the upper first bicuspid are small epithelial buds lying in the fibrous connective tissue half way between the lingual cusps of the first deciduous molars and the oral epithelium. (Fig. 25.) If the specimens are sectioned in the same plane in which the dental lamina runs from the oral epithelium to the outer enamel epithelium of the deciduous molar, it can be seen that the bicuspid germ branches off from the lingual side of the dental lamina. (Fig. 26, above.) At the age of 9 months, the germ of the first bicuspid is still located on the lingual side of the first deciduous molar. It is lying in a slightly higher level, approximately in the same plane as the tip of the lingual cusps of the deciduous molar and is surrounded on the lingual side by the crest of the bone. At about 1½ years, the bicuspid germ begins to differentiate into pulp and enamel organ. (Fig. 27, left.) At this time, it is located on the lingual side of the deciduous molar, in the same plane as the mesiobuccal root. From this time on the upper bicuspid germs are found near the mesial end of the corresponding deciduous molars. In the case of the first bicuspid, this can be noted from the presence of the permanent cuspid germ in the same field. (Figs. 27, left, and 28.)

At the age of 2½ years (Fig. 28, left), both the buccal and the lingual cusp of the first bicuspid show advanced formation of enamel and dentin. The cusps are not yet united at the occlusal fissure. The bicuspid germ at this time is already located between the mesiobuccal and the lingual root of the deciduous molar. The germ of the permanent cuspid is seen lying above the bicuspid germ. This position *above* the germs of all other permanent teeth is very characteristic of the cuspid at this age. Perhaps this position explains why the upper cuspid is more frequently malposed or impacted than any other tooth except the mandibular third molar.

At the age of 3 years (Fig. 28, right), the greater part of the enamel of the first bicuspid is formed. The enamel calcification is not yet completed as indicated by the fact that the enamel is still present after decalcification and stains dark pur-

ple with hematoxylin. In young tooth germs, the enamel is still visible after decalcification of the specimen. In older germs or in erupted teeth with mature enamel, the enamel is invariably completely dissolved by the acid. As a result, we sometimes find the entire enamel present, as in Figure 28, right. As the tooth grows older, the entire enamel is lost in the preparation of the specimen, and the surrounding soft tissues form only a replica of the former enamel, as in Figure 29, left. The topographic relationship between the permanent cuspid, the first bicuspid, and the first deciduous molar is very remarkable. At 4½ years, the crown is fully formed. At this time, the resorption of the root of the deciduous molar begins. (Fig. 29, left.) At 11 years (Fig. 29, right), the tooth has erupted. The pulp chamber is still very large and the root end is wide open. At the age of 15, the bicuspid has assumed its final position in the maxilla. (Fig. 30.)

Thus, the bicuspids describe almost a half circle around the deciduous molars. At birth, they are located directly *below* the deciduous molars. From here, they move over toward the *lingual* side, until, during the third year of life, they are *above* the deciduous molars. From here, they begin to move occlusally, resorbing the roots of the deciduous molar until they erupt.

There is neither time nor space to enter into the problem of resorption of the roots of the deciduous teeth. Our material contains some valuable information on this subject which has, in part, been used by one of us (R. K.) for a report on this question. Here, only one specimen will be reproduced, since it illustrates well the possibilities offered by the comparative study of roentgenograms and tissue sections through human jaws during the period of shedding of the deciduous teeth. Figure 31, above, shows a roentgenogram of the posterior portion of the jaw of a child of 11 years. The structures visible in this field are, from left to right, the germ of the third molar, the unerupted second molar, the bifurcation of which is just forming, the first molar, the second deciduous molar, the second bicuspid, a small root fragment of the first deciduous molar and the first bicuspid. Figure 31, below, shows a mesiodistal section through this specimen. This section, which is about 6 cm. long and 3½ cm. high and includes six teeth or tooth germs without preparatory distortion or tears, demonstrates again the possibilities of a correct celloidin technic for the sectioning of large calcified specimens. The mandibular nerve can be seen running directly below the open root ends of the second deciduous molar and the second bicuspid. This, by the way, is very interesting in connection with the problems of root development. Orban has shown, through measurements, that the roots do not, as was previously believed, grow *into* the jaw, but that the crown moves *out* of the jaw and, at the same time, the root becomes longer. These findings of Orban are fully corroborated by the specimen shown in Figure 31, below. The root ends of the second molar and of the second bicuspid are resting directly against the mandibular nerve. Since they cannot very well grow *through* the nerve, the only way in which these roots can develop further is by an occlusal movement of the entire germ, whereby the root ends form the fixed point. Attention should be called also to the presence of a small root fragment of the broken down first deciduous molar that is attached superficially to the gingival tissues.

HISTOLOGIC FINDINGS WITH REFERENCE TO TOOTH DEVELOPMENT

During the period between birth and

1 year of age, the permanent teeth develop to a very different extent. The first permanent molars and the permanent central incisors begin to calcify at birth or soon thereafter. In two of the specimens from new-born infants, which we examined microscopically, the first permanent molar consisted merely of soft tissues, pulp and enamel organ. In the third, the two mesial cusps of the lower first molars only showed earliest evidence of dentin and enamel formation. At the age of 6 months, the upper and lower central incisors, the lower lateral incisors and the four first permanent molars show considerable progress in calcification. A portion of the incisal edge of the incisors is formed, and four calcified cusps of the first permanent molar are about to unite at the fissures. The next tooth in line of development is not, as might be expected from the order of eruption, the permanent lateral incisor, but the permanent cuspid, which is almost as far advanced in its development as the central incisor. (Figs. 13, right, and 21, right.) The upper permanent lateral incisor at this time consists merely of a small epithelial bud without any further differentiation, lying on the lingual side of the deciduous lateral incisor. (Fig. 15, left.)

This reveals a remarkable fact. The permanent central incisors and the cuspids develop almost simultaneously, although the latter erupt five or six years later than the incisors. The upper permanent lateral incisor, which erupts practically at the same time as the central incisor, is far behind in development. Its calcification does not begin until the child has reached the age of 1 year or even more. Then, the lateral incisor develops very rapidly, "making up" for the early delay, so that, at the age of 2½ to 3 years, the central and lateral incisors have reached a nearly identical stage of development. The development of the cuspids progresses much more slowly. The calcification of the upper cuspid, for instance, begins more than a half a year before that of the upper lateral incisor, but at the time when the crown of the lateral incisor is fully formed, the enamel of the cuspid is still in the process of development.

It is interesting to look for an explanation of the marked delay in the development of the upper lateral incisor. One of the reasons for it may perhaps be the lack of space in the anterior portion of the maxilla in early life. The permanent germs soon attain their full mesiodistal width. (See the permanent central incisor, Figure 19.) Under these circumstances, there is hardly enough space between the median line and the cuspid region for a simultaneous development of both central and lateral incisors. Therefore, the lateral incisor is held back until, after the first year, the increased dimensions of the maxilla offer sufficient space for the growth of the lateral incisor.

Another point that must be kept in mind is that while the central incisor and the cuspid are very constant and only very seldom are found to be congenitally missing, the upper lateral incisor has a marked tendency toward underdevelopment or complete absence. Bolk expressed this very plainly by saying that the upper lateral incisor is a "doomed" tooth, a tooth that will gradually disappear in the process of reduction that leads from the primeval mammalian dentition to the modern one. It is, therefore, not surprising that the upper lateral incisor should occupy a less important position from the beginning, and that its development should be delayed as compared to the phylogenetically far more important central incisor and cuspid. Contrary to what has

been observed for the upper lateral incisor, the lower lateral incisor is very constant and rarely ever absent or underdeveloped.

epithelial buds located to the occlusal side and opposite the lingual cusps of the deciduous molar that is later to be replaced by them. At the age of 9 months, for instance, they are still in this dormant stage. Not until after the first year do the bicuspids show evidence of beginning differentiation into pulp and enamel organ. The first evidence of calcification was

TABLE 2.—TIME OF BEGINNING CALCIFICATION OF THE PERMANENT TEETH

Upper Jaw — Tooth	Legros-Magitot (Reproduced by Noyes, Bödecker)	Peirce	Black	Brady	Churchill	Author's Findings
1	1st month	1st year	1st year	1st year	2 months	3 to 6 months
2	1st month	2nd year	2nd year	2nd year	2 months	1 year to 15 months
3	1st month	3rd year	3rd year	3rd year	4½ months	3 to 6 months
4	1st month	4th year	5th year	4th year	3 years	1½ to 2 years
5	1st month	5th year	5th year	4th year	4 years	2 to 2½ years
6	6th (fetal) month	25th (fetal) week	Before birth	25th (fetal) week	9th (fetal) month	1 to 4 months
7	3rd year	5th year	6th year	5th year	4 years	2 to 2½ years
8	12th year	9th year	9th year	8th year	8 years	7 to 9 years
Lower Jaw — Tooth						
1	1st month	1st year	1st year	1st year	2 months	3 to 6 months
2	1st month	2nd year	2nd year	2nd year	2 months	3 to 6 months
3	1st month	3rd year	3rd year	3rd year	4½ months	3 to 6 months
4	1st month	4th year	5th year	4th year	3 years	1½ to 2 years
5	1st month	5th year	5th year	4th year	4 years	2 to 2½ years
6	6th (fetal) month	25th (fetal) week	Before birth	25th (fetal) week	9th (fetal) month	1 to 4 months
7	3rd year	5th year	6th year	5th year	4 years	2 to 2½ years
8	12th year	9th year	9th year	8th year	8 years	7 to 9 years

A relationship similar to that which exists between the upper central and lateral incisors is also observed between the cuspids and the bicuspids. During the entire first year, the bicuspids are small

found in the upper first bicuspid at the age of 2 years, in the second bicuspid about one-half year later. At this time, the bicuspid germ is well advanced in the migration toward its final position between the diverging roots of the deciduous molar. The formation of the crowns of the bicuspids is finished between 4 and 5 years of age.

These data show the gross incorrectness of the table of Legros and Magitot. (Table 2.) In this table, the same time is given for the onset of calcification of incisors, cuspids, bicuspids and first molars. In reality, the lateral incisor is at least one year behind the central incisors, the cuspids and the first molars, whereas, the bicuspids are from two to two and one-half years behind the central incisors and the first molars.

This observation can best be corroborated by a study of permanent teeth with enamel hypoplasia. We know that if the condition resulting in enamel hypoplasia persists only for a short time, all forming teeth will be affected at once and to a similar extent, the position of the hypoplastic defects on the crown depending on

TABLE 3.—RELATIVE DISTRIBUTION OF HYPOPLASTIC DEFECTS IN THE PERMANENT TEETH

	7	6	5	4	3	2	1	1	2	3	4	5	6	7
I	7	6	5	4	3	2	1	1	2	3	4	5	6	7
II	7	6	5	4	3	2	1	1	2	3	4	5	6	7
III	7	6	5	4	3	2	1	1	2	3	4	5	6	7
IV	7	6	5	4	3	2	1	1	2	3	4	5	6	7

*Boldface type indicates the teeth affected; †indicates that only the incisal edge and tips of th cusps are affected; ††, that about one-third of the crown is affected; †††, that about two-thirds of the crown are affected, and ††††, that the entire crown is affected.

the stage of development that the tooth had attained at that particular time. If all permanent teeth were calcifying simultaneously, hypoplastic lesions should be distributed uniformly over all teeth. But this is by no means the case. (Fig. 7.) Table 3 shows the relative distribution of enamel hypoplasia as to kinds of teeth involved and extent of involvement. These clinical findings are an accurate check of the correctness of our histologic findings in the problem of calcification of the permanent teeth.

In any study of this type, it must be understood that the ages given in connection with tooth development are only relative. Variations from a few months to even years occur and are rather common. The great individual variations in birth weight, body development, general state of health and eruption of teeth are sufficiently known. They account for these irregularities. Our figures are true and correct as far as the *relative* development of the different permanent teeth is concerned. If the calcification of the permanent central incisors starts at 2 months, the first bicuspids will begin to calcify at about 1½ years. If the calcification of the central incisor occurs six months later than would normally be expected, all the other germs are concurrently delayed in their development, and the bicuspids will in all probability not begin to calcify before the second year.

From our findings, the following practical conclusions can be drawn regarding surgical interference with the jaws: At the time when the wiring of the cleft jaw is usually performed (between the second and fourth months), no permanent germ is in the way of the wire in the field *above* the deciduous lateral incisor or *above* the first deciduous molar. At this time, the bicuspid germs are very small epithelial buds located on the occlusal side of the deciduous molars. These germs are more likely to be injured by an incision overlying the mandibular ridge or just linguad from it at any period from birth to 2½ or 3 years of age (Langenbeck operation). As they are completely out of the route of the typical location of wire sutures, that operation cannot of itself be held responsible for any irregularities or absence of teeth in the bicuspid region.

In Table 2, the statements concerning the beginning of calcification of the permanent teeth as found in the various dental textbooks are reproduced. In the last column, the results of our own investigations are inserted. Realizing the impossibility of setting any definite data for the beginning of a biologic process, we give each tooth three months leeway. For instance, we feel that, in saying that the calcification of the permanent central incisors begins on an average between the ages of 3 and 6 months, we take into consideration the possible variations in development as indicated by the birth weight and postnatal growth. It should again be emphasized that the intervals between the beginning of the calcification of the individual teeth seem to be constant regardless of whether the first onset of calcification is at birth or three months later.

TABLE OF RELATIVE DISTRIBUTION OF HYPOPLASTIC DEFECTS IN THE PERMANENT TEETH

Table 3, showing the distribution of enamel hypoplasia, is compiled from clinical observation of numerous cases. It must, of course be understood that there are gradual transitions between the conditions marked I, II, III and IV, and also that minor individual variations in the relative extent of the defects on the various teeth are found.

I. Mildest degree of hypoplasia.

Only the incisal edges of the upper central incisors and of the lower central and lateral incisors are "nicked." The cusps of all four first permanent molars show minor hypoplastic defects. The upper lateral incisors are invariably free from hypoplasia in such a case.

II. About one-third of the crown of the upper central incisors involved. The lower central and lateral incisors are affected to the same extent. All four cuspids show hypoplasia of the tip, covering about half as much of the tooth surface as in the corresponding central incisors. The cusps of the first permanent molars are affected approximately to the level of the occlusal fissures. The upper lateral incisors are not involved nor are the bicuspids and second molars.

III. About two-thirds of the crown of the upper central incisors involved. The lower central and lateral incisors are involved to the same extent. The cuspids show hypoplastic enamel on the incisal one-third or one-half of the crown. The first permanent molars show marked deformity and hypoplasia on about one-half the crown. The upper lateral incisor is affected only at the incisal edge. The bicuspids are intact or occasionally present a chalky appearance at the tip of the buccal cusps. The second molars are intact.

IV. The central incisors showing hypoplastic defects over the major portion of the crown or over the entire crown. The same, or nearly the same, amount of involvement is found on the lower lateral incisors, the cuspids and the four first permanent molars. On the upper lateral incisors, about one-half the crown is involved. The bicuspids show hypoplastic defects on the cusps. Usually, the first bicuspids are slightly more affected than the second bicuspids. The tips of the cusps of the second permanent molars are affected.

CONCLUSIONS

The relative distribution of hypoplastic defects establishes beyond any doubt the order of calcification that has been given in Table 2. It is evident that the teeth can be placed in three definite groups, the calcification and development of which takes place more or less concurrently. These groups are, in order of their calcification:

First: Upper and lower first permanent molars, upper and lower central incisors, lower lateral incisors and upper and lower cuspids.

Second: Upper lateral incisors.

Third: Upper and lower bicuspids; upper and lower second permanent molars. (The third molars are not considered here since their calcification usually begins at a later time than hypoplastic lesions usually originate.)

From the foregoing, the incorrectness of all data on the beginning of calcification available in dental literature is evident. Why this should be the case it is difficult to explain. Still more surprising, to our minds, is the fact that the old table of Legros and Magitot, according to which all permanent teeth from central incisor to first molar begin to calcify at the same time, was copied over and over again, and apparently no one found it worth while to see whether the statements contained in the table were correct before commending it to dental students and to the profession.

In this connection, it is interesting to note that the only correct reference to the order of calcification of the upper anterior teeth that could be found in dental literature was made by a dentist from Vienna, Zsigmondy, in a paper on enamel hypoplasia read before the World's Columbian Dental Congress (Chicago, Ill.) in 1893. From the distribution of enamel hypoplasia, he came to the fol-

lowing conclusion: "In the upper jaw the order of calcification is (1) central incisor, (2) cuspid, (3) lateral incisor: in the lower jaw, (1) central incisor, (2) lateral incisor, (3) cuspid." Zsigmondy, apparently uninfluenced by any tables or previous statements of authorities, drew from his clinical findings what would seem to be the only logical conclusions. Forty years later, the incorrect data of Legros-Magitot, Peirce, Black and others, with reference to the anterior permanent teeth, are still copied in textbooks. This again proves that in science nothing should be accepted until the entire problem has been carefully checked and found to be correct.

SUMMARY

1. Heretofore, a sufficient number of data have not been available in dental literature on the development, calcification and topography of the human teeth during the period from birth to the time when the permanent teeth come into occlusion. The tables most frequently used for reference on this subject were the ones of Legros and Magitot, Peirce and Black. These tables contain a number of incorrect data.

2. The types of specimens illustrated in older textbooks on dental histology and in publications on this subject consisted of bone specimens (skulls) and gross anatomic sections. Neither type of specimen adequately illustrates the early stages of tooth development, nor do they record the topographic relationship between the tooth germs and the surrounding and adjacent structures of the jaws. This lack of knowledge of the anatomy of the child's maxilla and of the topography of the tooth germs has led to the drawing of numerous incorrect diagrams by men who were interested in this problem from the viewpoint of cleft palate surgery and who could not find sufficient information in the contemporaneous literature.

3. The present investigation was made on twenty-five human jaw specimens ranging in age from birth to 15 years. These specimens were removed from the bodies usually not later than a few hours after death. They were fixed in formaldehyde and alcohol, after which photographs, plaster casts and roentgenograms were taken. Then the specimens were decalcified and embedded in celloidin. Serial sections were prepared, mounted on large slides and stained with hematoxylin and eosin. These sections show the tooth germs and surrounding tissues in good histologic fixation and in undisturbed position. They give evidence for definite conclusions as to the state of development and calcification of each germ. They show clearly the changes in the relative position of the deciduous and permanent teeth from the earliest development of the permanent germ from birth to the completed resorption of the deciduous tooth and its replacement by the permanent tooth.

4. From large cross-sections through the entire width of the maxilla at different ages, from sagittal sections through the entire head and neck and from horizontal sections through the maxilla, the position of certain clinical landmarks, such as the cuspid eminence and the attachment of the zygomatic bone to the maxilla, can be visualized. These sections also make it possible to study the attachment of the lips to the labial lamina of the maxillary bone, the position of the nasal cavity in relationship to the tooth germs, the location and development of the maxillary sinus and the structure and relative position of cheeks, hard and soft palate and tongue.

5. The development of the permanent teeth by no means coincides with the time

of eruption of these teeth. The calcification of the central incisors, the lower lateral incisors, the cuspids and the first permanent molars begins from one to two years before the calcification of the upper lateral incisors and the bicuspids. The order of calcification of the permanent germs is as follows:

Upper jaw: The first permanent molars begin to calcify shortly after birth. The generally accepted opinion that their calcification is well advanced at the time of birth is incorrect. The calcification of the permanent central incisors begins soon after the first permanent molar. Next follow the permanent cuspids. At the age of 6 months, these three teeth (central incisor, cuspid and first permanent molar) are the only ones in the upper jaw to show calcification of the occlusal portion of the crown. The germs of the permanent upper lateral incisors and the bicuspids, during the first year, are small epithelial buds without further cell differentiation. The calcification of the lateral incisor begins after the first year, that of the first bicuspids at about 1½ years and that of the second bicuspid at about 2 years.

Lower jaw: In the lower jaw, the central incisor, lateral incisor, cuspid and first molar develop almost simultaneously, the first molar being one or two months ahead of the incisors. The lower bicuspids remain small epithelial buds during the first year, and show no further differentiation until about 1 year. They begin to calcify at from 1½ to 2 years.

6. The germs of the permanent incisors, permanent cuspids and bicuspids branch off from the lingual side of the dental lamina of the corresponding deciduous teeth. They are originally located in the fibrous connective tissue overlying the deciduous crowns on the occlusal side of the deciduous teeth. In the course of the growth of the maxillary ridge and during the occlusal movement of the deciduous teeth, the permanent germs are left behind by the deciduous teeth. Thus, they become located more and more on the lingual side of the deciduous teeth, and, at the same time, are surrounded and encapsulated by the lingual portion of the bone. As the deciduous teeth continue to move occlusally, the permanent germs finally assume a position above or between the roots of the deciduous teeth.

This movement of the permanent tooth germs from the occlusal side of the deciduous teeth to the lingual side and finally to a position above the deciduous roots is true of every permanent tooth which has a deciduous predecessor, in both the upper and lower jaw. At birth, the permanent central incisors, lateral incisors and cuspids have already reached a position linguad from the deciduous teeth, and the bicuspids are still on the occlusal side of the corresponding deciduous molar teeth. The calcification of the permanent germs does not begin until they are located well toward the lingual side of the deciduous teeth and nearly or entirely embedded in the lingual alveolar bone. This position is reached by the central and lateral incisors, and cuspids soon after birth. The bicuspids do not occupy the position on the lingual side of the deciduous molars until the age of from 1½ to 2½ years on the average.

7. For the surgical procedures connected with cleft palate operations, the following conclusions can be drawn from these findings. At the time when wiring through the upper jaw is preferably performed (between the second and fourth months), the tooth germs are lying in the jaw in such a crowded position that passing wires *between* them (Fig. 20, below), as originally suggested by the advocates of the direct application of force, is now

known to be impossible. It is possible to pass wires or other suture material through the maxilla *above* certain germs, at a point mesiad from the cuspid eminence and distad from the deciduous and permanent central incisor germs, or immediately above the deciduous lateral incisor. A second point of entry is located in the field between the cuspid eminence and the zygomatic process above the first deciduous molar germ. (Fig. 32.) If the points of entry for the wires are high enough and at the exact landmarks specified, the only possibility of injury to the germs is that which confronts the operator when sufficient care has not been exercised in the location of the very definite anatomic landmark described.

Attention of all members of the profession who perform surgical operations for closure of complete congenital clefts or those clefts which extend to the maxillary ridge is invited to the necessity of obviating the making of incisions through the attached overlying soft tissues on the lingual aspect of the maxillary ridge for any considerable distance from the border of the cleft on either the long or short fragment for the purpose of elevating the periosteum for coaptation in the median line. Nor should such incisions be made for the purpose of everting or transferring of this tissue toward the center of an open cleft until the patient is at least 1 year of age, for the germ of the permanent lateral incisor is encased in the fibrous tissue of the maxillary ridge and not within the bone forming the maxillary ridge during this period. Furthermore, the germ of the permanent central incisor is not yet within the bone of the ridge in the first six months.

Because of the above-established facts and our belief that the most uniform development of the upper jaw may, to an important degree, be influenced by the establishment of a relatively normal floor to the defective nasal fossa, through which the cleft passes, we favor the early closure, not only of the cleft through the maxillary ridge, but also through the hard palate for at least its anterior three-fourths (with everted flap [Fig. 32, right]), by preference some time between the second and fourth month. To bring this about with the least possible danger to the structures under discussion, at a time when a number of the permanent teeth are not yet within their bony crypt, we felt called on to change our technic (but not necessarily the principles) from that laid down by Langenbeck, Davies-Colley, Ferguson, Mears-Roe, Lane, Brophy and Veau. It should be made clear that any one of the foregoing operations could safely be used for the surgical closure of a cleft involving the hard palate after the germs of all permanent teeth have passed from the investing soft tissues to the underlying bone; but it is our belief that the best end-results will be assured when the congenital defect is closed in the manner and to the degree indicated, previous to the transition of these permanent germs from the soft tissues to the underlying bone.

Caution is also urged against the adoption of any surgical technic that calls for the passing of elevators or knives through the fibrous tissue overlying the maxillary ridge in the field of the occlusal surface of the deciduous molars or to the immediate lingual aspect previous to a date somewhere between the second and third year; for, during this time, the germs of the bicuspid teeth are passing from the occlusal aspect of the deciduous molars to their lingual side and they do not enter the bone in the majority of instances at a time much previous to 2 years for the first bicuspids and 3 years, on an average, for the second bicuspids.

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USES AND ABUSES OF ORTHODONTIC APPLIANCES*

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THERE has never been a more propitious time for careful and serious study of the uses and abuses of orthodontic appliances. It is an undisputed fact that the present status reveals that orthodontic appliances have reached their highest point of perfection in construction and usefulness in the history of practice. There has not, however, been an appliance devised that meets the requirements of universal use. It may be said that these facts are responsible for many of the abuses that are now prevalent.

The evolution of orthodontia embodies two distinct phases or divisions; namely, the biologic and the mechanical. One may, I think, speak of the development as scientific. In the process of growth, it has always been true that those things related to the biologic aspect have preceded those allied to the mechanical; although, in later years, the development of knowledge in both has run somewhat concurrently.

Malocclusion of the teeth was recognized as a deformity and its detrimental effect on the individual recorded many years before any means for correction had been devised. The opinion has prevailed generally that the development of mechanical devices for correction of malocclusion of the teeth was simultaneous with the recognition of the condition. This conclusion has no basis in fact. Attention was called to irregularities of the teeth by Hippocrates, who, in the sixth book of Epidemics, wrote, "Among those individuals whose heads are long shaped, some have thick necks, strong members and bones; others have strongly arched palates, their teeth are disposed irregularly, crowding one on the other and they are molested by headaches and otorrhea."

The first authentic report of the use of mechanical devices for the correction of malocclusion of the teeth was recorded as late as the early part of the eighteenth century. The most comprehensive report is contained in a chapter of Fauchard's "Treatise of Dentistry," published in 1728.

It is interesting to note, in contradistinction to the viewpoint of many in the dental profession today, that, throughout the entire period of development of orthodontia, the outstanding investigators in the field considered the biologic problems primary and paramount and the mechanical devices only a means to an end. They are, of course, inseparably connected as far as the study and treatment of malocclusion is concerned and, therefore, are so closely interrelated that the successful management of a case is dependent on a clear conception of both. A study of the biologic problems will reveal facts that are essential to a diagnosis and a prognosis

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and is the only means by which a method of procedure can be determined in treatment.

When the day comes that the circle is squared and the philosopher's stone is discovered, and only then, can the biologic be separated from the mechanical in the successful practice of orthodontia.

Your attention may be appropriately called to a situation which does exist in regard to the use of the term "biologic phase." This term has become almost a byword and is mouthed here and there on nearly all occasions when orthodontic problems are discussed. In fact, its use has become so commonplace, a sort of fashion, that one is frequently amazed to hear some men proclaim with great pride their interest in this field and their inherent ability to understand and solve the intricate problems related to it. The real investigators assume a more rational attitude. These men have always made an honest effort to determine cause and effect as related to malposed teeth, malformed dental arches and maldeveloped jaws.

Through all the years of the development of the art and science of orthodontia, men who have paused long enough to make inquiry into the problems involved in its practice have believed and do believe now that mechanical devices for the application of force to move teeth cannot be intelligently and safely employed without a reasonable knowledge of those conditions ever present and which must be confronted in the care and treatment of a delicate complex living organism; and, further, that a clear understanding must be had of the fundamental principles embodied in an orthodontic appliance and the things involved in its use and management.

Advancement in orthodontia has not been meteoric nor has it been characterized by an uninterrupted success in adventure. Its problems have been intricate and complex and its unfolding slow and tedious. It has experienced dark periods of depression and recession as well as more hopeful ones of success and advance. For the most part, until the beginning of the twentieth century, investigators in the field of orthodontia individualized their work. There was practically no collaboration and little, if any, correlation of the work that had been accomplished. Most of the pioneers were loath to accept ideas other than their own, and these, if found to have merit, were usually kept within the confines of their own domiciles. These men were mostly located in comparatively distant parts of the country and there was little opportunity for team work, even though some of them would have welcomed such an opportunity. In the last few years, because of concentration in thought, collaboration between scientist and clinician, standardization of methods, organized inquiry in the biologic field, and the development of the mechanical phase, progress in orthodontia has been definite and secure. This experience has disclosed the fact that the practice of orthodontia is primarily a specialty which requires certain qualifications peculiar to itself. I would not have you interpret this statement to mean that every person who desires to treat cases of malocclusion must of necessity devote his time exclusively to orthodontia, but I do claim that anyone who ventures into this field of endeavor must be qualified to render a satisfactory service. Proficiency in this work is absolutely necessary.

Unfortunately, the knowledge developed in the orthodontic field has been

confined largely to the relatively small group making up the specialty. Its dissemination has been limited and, in many respects, restricted. There has never been adequate provision made in the curriculum of the dental schools for sufficient instruction to the undergraduates, nor have there been organized enough graduate courses to meet the demand of or the necessity for orthodontic education. The attendance at orthodontic meetings has been largely confined to specialists. Dental publications have carried but occasional articles on the subject, there being little or no correlation of these. Presentations on the subject have been restricted at dental meetings. Papers and clinics at dental meetings have not been coordinated and orthodontic publications have a limited distribution. As a result of these conditions, the members of the profession at large have had but little opportunity to acquaint themselves with orthodontic problems. When facing these facts, one hesitates to condemn the failures of those who were honest in their endeavor to render orthodontic services, but who were lacking proficiency and experience. Contrariwise, it is evident that condemnation will beset those who, in the face of available knowledge, deliberately attempt for remuneration alone to correct malocclusion without the least conception of the problems involved in orthodontic care and treatment.

The status of orthodontia precludes the possibility of acquiring sufficient information or knowledge to carry on orthodontic procedures by reading articles in dental journals, by hearing papers and seeing clinics at dental meetings, from receiving the instruction given to undergraduates or by taking short special courses of instructions. All of these must be supplemented by association with an orthodontist of known ability or by continuing study in a recognized graduate school. The character of this work is such that treatment extends over a long period, and it cannot be determined in a few weeks whether a person is capable of carrying the cases through to a successful conclusion.

There have been many and varied definitions proposed to describe an orthodontic appliance, all of which put them in the category of mechanical devices placed in the mouth for the purpose of moving malposed teeth into correct occlusal relationships. This is the essential part they play in the general scheme of orthodontic practice. Appliances are divided into two rather distinct classes or types; namely, fixed and removable. In the fixed type, the anchorage is substantially made to the teeth so that the base part of the appliance can be adjusted or removed only by the operator. The removable type is so constructed that it can be adjusted or removed by either the patient or the operator. The fixed type lends itself to the addition of a large number of components; the removable type to a comparatively few. There are indications for the use of both types of appliance, and neither can be excluded from a well-rounded orthodontic practice. There are those who believe that the fixed type has far greater potentialities, and there are those who hold to the same opinion regarding the removable. I have seen good results from the use of both and in my own practice employ both, the removable type rather sparingly. My preference lies strongly with the fixed appliance as, in my opinion, it has many distinct advantages. It certainly is more definite in its action and more commonly used. I do not think that a person should be criticized for using the type of appli-

ance that he believes to be indicated and with which he can produce satisfactory results. An appliance can be evaluated only by its worth in producing results under proper management and favorable conditions; but I do believe that familiarity with the various designs, of which there are many, will enable one to make the best selection. It is a mistake and a sad commentary on our present knowledge for one to confine himself to the use of a single type of appliance.

I hesitate to say that too much importance can be placed on the efficiency and scope of orthodontic appliances, but it is no doubt true that a considerable number of orthodontists and dentists who are treating malocclusion do so at the expense of other vital considerations. Appliances are, of course, an essential part of the armamentarium of the orthodontist, an accessory on which he must depend, but, relatively, they are to him what the paint is to the artist, the violin to the violinist, the knife to the surgeon, the stethoscope to the internist and the laboratory to the scientist.

The intelligent use of an orthodontic appliance is dependent to a major degree on the concept one has of those factors in development and growth, hereditary traits and character, functional activities and disturbances, the various individual reactions of cells to stimulation, environmental conditions, dissimilarity of parts, anatomic variations, inharmony in the relative amount of tooth structure present, pathologic tendencies and conditions, the relationship of arch form to the underlying or apical base, habits, peculiar individual susceptibilities, facial art, the symmetry of associated parts, malformation, balanced forces of occlusion and occlusion; and, further, on the knowledge possessed by the operator regarding the basic principles in the construction of appliances and the application of force, and on his judgment, integrity, experience and technical ability.

I have frequently been asked, "Do you think a general practitioner should treat malocclusion?" My answer is, "Yes, provided he is qualified to do so." This question is significant. According to conservative estimates, more than 50 per cent of all children are in need of orthodontic service. Under present conditions, only a small percentage are able to receive it. This situation immediately resolves itself into a serious economic problem and one which is difficult of solution. It is evident that the general practitioners have a great responsibility in this field. This responsibility cannot be discharged by an attempt to render a service without first having adequate training in the subject. The solution, I think, lies more in the field of prevention than that of correction. There are many cases of approaching malocclusion than can be prevented from further development and there are many cases of incipient malocclusion that can be corrected by the simplest methods. It is the responsibility of the general practitioner to recognize these cases, to make a correct diagnosis and to give the proper advice. The practice of permitting continuous development of a deformity is certainly to be condemned.

It is also an obligation of the dentist as well as of the orthodontist to recognize the class of cases that are amenable to treatment under his care. There are cases that are beyond the limitation of treatment. It is quite certain that miracles cannot be performed with an appliance. One of the most important things in the consideration of treatment is the question as to whether the case

comes within the scope of orthodontic procedure. Many failures are the result of mistakes in this respect. It has been my observation that the inexperienced orthodontist and the dentist are not infrequently inveigled into undertaking the impossible. In these cases, too much confidence is placed in the efficiency of the appliance and not enough attention is paid to the biologic factors involved.

There is a series of categorical events leading up to and continuing during treatment that must be observed if anything approaching satisfactory results are to be obtained. The following are some of the more important ones:

The existence of a definite malocclusion; a correct diagnosis; the employment of preventive measures; removal of the cause or causes; the elimination of pathologic conditions; the physical condition of the patient and of the teeth and supporting structures; the age, accessibility, cooperation and nervous reaction of the patient; environmental conditions and habits; methods indicated; the selection and adjustment of the appliances; the management and change of appliances; susceptibility and nonsusceptibility to mechanical stimulation of growth; endocrine activities; susceptibility to functional disturbances and disease; occlusal classification and adjustments; the judicious extraction of the deciduous and permanent teeth; careful attention to periods of rest and periods of activity; proper attention to mouth hygiene; roentgenographic surveys and adequate retention.

The patient has the right to presuppose that the orthodontist or dentist engaged to render a service will do so upon this premise.

I quote from a previous paper:

> An appliance to be useful and efficient must possess certain basic principles. They should be made of a material which can be bent and shaped without injury and which will permit soldering without change of temper; strong enough to withstand the natural force of mastication and impervious to the effects of the action of mouth secretions. They must be constructed to provide adequate anchorage so that they will not be distorted or changed in position with the application of force. They should be delicate though strong, simple though efficient, should provide the minimum interference with function, and should permit reasonable prophylactic care by the patients. An appliance should consist of as few parts as may be necessary to meet the requirements of the case and so constructed that components can be added or taken away without destroying the original design. They should provide for individual tooth movement and control and should exert only force enough to cause the teeth to move. They should be capable of moving a tooth in any desired direction and should be under control only of the operator. Appliances should be changed as often as indicated and simplified when possible as treatment progresses. It is poor practice to continue to treat a case with an appliance which may have been required in the beginning, which has performed its function and which could be replaced by a more simple and more efficient design. This plan, unfortunately, is followed by many orthodontists and is probably due to procrastination, carelessness or a lack of comprehension. In the treatment of all cases, appliances should be eliminated as rapidly as possible.

In the use of an appliance, only components that are indicated in the treatment of the case should be added, but those should be added without hesitation and without delay. There has been much criticism regarding the use of accessory bands and brackets. Orthodontists have endeavored to devise and substitute other means for individual tooth control. In my experience, I have found that the most efficient and most certain means of gaining this control are bands and brackets, wherever their use is indicated. It is useless, in many cases, to attempt to rotate teeth without bands

as the medium of attachment beween the teeth and the base arch. They may also be used frequently to stabilize the base arch and finger springs that may be attached. When the labial arch is used, it should, in most cases, be stabilized somewhere between its points of anchorage by the use of plain bands and brackets. In many cases, the lingual arch should also be more firmly fixed by the use of additional bands with lugs soldered on the lingual surfaces under which the arch is placed. It frequently happens that a well designed appliance is made useless by the failure of the orthodontist to observe these points. An appliance is of little value unless all its parts are properly anchored. It is not uncommon to see the labial arch riding up and down on the anterior teeth, with each movement putting a severe strain on the anchor teeth. It is more common to observe the lingual arch doing the same thing. These are distressing sights, to say the least, and can be accompanied by only one result, failure.

One of the most obvious mistakes in the use of the lingual arch is overloading of the base wire with too many finger springs, and the application of too much pressure, when the anchorage becomes loose and unstable and the arch is displaced. It is quite certain, in the use of any appliance, that the part from which force is to be applied must be fixed so that it will not be displaced or distorted. It is equally essential that only enough force be applied to move the teeth in the desired direction. One might surmise, from their bulk and crudeness, that some of the appliances advertised and recommended to dentists for treating malocclusion, were primarily designed for lifting an automobile or moving a house.

In recent years, in alining the six anterior teeth, I have found it desirable to use a small diameter labial arch, 0.022, 0.025, 0.030, but not throughout the entire length. A 0.040 wire is used to engage the buccal anchorage tubes on the molar teeth and is carried forward to approximately the mesial surface of the first bicuspids. It is then spliced with the smaller gage wire which forms the anterior segment. This is adjusted in suitable brackets soldered to bands on the anterior teeth. Lugs or loops are also soldered to the bands to serve as attachments from the arch to the teeth with ligatures. It is seldom necessary to place bands on the bicuspids, about the only indications being for rotation or changing the occlusal plane. When this is necessary, the 0.040 posterior segments of the arch can be shortened, and the small wire forming the anterior section lengthened. The principal advantages are better stabilization of the posterior part of the arch and more resiliency of the anterior.

There are many modern satisfactory designs of appliances for use in orthodontic procedures. The materials have been refined and the technic of construction has been improved and simplified. There is no good reason for an orthodontist or a dentist to place an inefficient, archaic or poorly constructed appliance in the mouth.

It may be presumptuous to make a statement without having documentary evidence to substantiate it, but it is probably true that orthodontic appliances are abused more than any other factor in dentistry. In using "abuse," I refer to that part of Webster's definition of the word which states, "to put to a wrong or bad use; misapply; misuse; pervert." I have no doubt that every orthodontist, at some time during his career, has been guilty of this charge

and that it is a common occurrence with the pseudo-orthodontist and the dentist treating malocclusion without training and having but little conception of orthodontic problems.

The abuse of an orthodontic appliance may occur in various ways. The well-trained orthodontist may be guilty because of carelessness in construction and neglect in operation; the pseudo-orthodontist abuses the appliance because of lack of training and understanding; and the dentist does so because he is inveigled into attempting to render a service for which he is not qualified.

For a number of years, the supply houses and the laboratories have been putting out advertising material which is deceptive to the average person. It is made to appear that the only thing necessary in the treatment of malocclusion is the application of a mechanical device.

The supply houses have been more respectable in this regard than the commercial laboratories. There is no denying the fact that some of the supply houses have contributed materially to the development of appliances. It has been largely through their experimentation with materials that these have been brought to the present state of perfection, and it has been mostly through their efforts that the various parts of appliances have been refined and standardized. They have been willing to take the chance in financing this work, which has been a great benefit to the orthodontist. For all of this, the orthodontist should be grateful and should recognize his obligation. On the other hand, the persistent effort to promote the use of appliances in the hands of the unskilled must be condemned as an unsafe practice.

The commercial houses, quick to recognize the fact that there are numberless cases of malocclusion that can never reach the office of the specialist for treatment, have taken advantage of the situation to vend their wares by urging the general practitioner to undertake treatment on a basis which they chose to establish.

The situation reminds one of the remarks of Brutus regarding Caesar, "As he was valiant I honored him, but as he was ambitious I slew him."

It is not my desire or intention to criticize anything except that which I believe applies to the abuse of orthodontic appliances. It is difficult to become reconciled to a situation in which a supply house advertises for general use by the profession an appliance which it requires the greatest skill and experience of the orthodontist to assemble, adjust and operate. This appliance has many virtues and, when used properly where indicated, is capable of producing excellent results, but, in the hands of a novice, it is a dangerous weapon.

In setting forth the claim that an appliance can be used almost with impunity by anyone, at the same time disregarding all other factors in treatment, the manufacturer is doing a great wrong to the patient and to the dentist or orthodontist.

As stated earlier in this discussion, the successful use of an appliance depends on the knowledge that one has of other orthodontic problems. The simple placing of an appliance in the mouth does not meet this requirement. The dentist cannot be trained to treat malocclusion by reading the pamphlets that are sent out describing appliances, or by reading articles published in the dental journals. The technic and management is so exacting that a long course of study supplemented by practical experience is required before one is capable of accom-

plishing satisfactory results and before the danger of doing a serious damage to the patient is eliminated.

As bad as the practice of the supply houses may seem, it does not approach the flagrant and damaging advertising propaganda of some of the commercial laboratories. When a laboratory requests the dentist to send in a set of models from which, it is stated, a diagnosis will be made, treatment prescribed and appliances constructed, and, further, informs him that the case will be supervised and the appliances changed from time to time as treatment progresses, the situation has reached its limits. This kind of practice is an insult to the intelligence of an honest person and is obviously nothing but a commercial project.

I must confess that I know of no way by which a dentist can get into such serious difficulty as by following the advice of these laboratories. This method discounts immediately the fundamental principles of orthodontic practice, both biologic and mechanical, and leaves in default all of the scientific attainments. It is an exploitation of the credulous and a prostitution of orthodontia.

To quote from a circular letter received from a laboratory a few months ago:

Dear Doctor:—

The ideal time to start orthodontic treatment is during the summer vacation, which is now at hand. If you are not now taking orthodontic cases, why not permit us to assist you in this important and profitable part of dental practice?

Our years of experience in making appliances qualifies us to be of real help to the dental profession.

Dentists all over the country are taking advantage of our service and find it highly satisfactory as well as adding materially to their income.

We do not advocate a certain type of appliance but construct appliances which our years of experience has taught us is ideal for the case, and when properly directed produces the desired result.

We would be very glad to have you send us your models for suggestions and prices.

Yours very truly,

Here is the ridiculous example of a laboratory presuming to teach the dentist how to use, or rather abuse, an orthodontic appliance. The function of a laboratory cannot possibly extend any farther than the construction of an appliance under the supervision of the dentist. No doubt, the primary object of this plan is to entice the dentist to attempt orthodontic procedures so that the profits of the laboratory may be increased.

The present economic conditions have so changed the character of the average dental practice that men are more gullible and are more likely to fall prey to the advertising propaganda of these concerns.

There are probably more cases of malocclusion being treated by the general practitioner today than by the orthodontist. According to the report of a survey made by the Committee on the Costs of Medical Care, more than 20,000 dentists are treating malocclusion. No criticism should be made when the dentist is trained and qualified to render such service. In fact, it is necessary and commendable, but there is serious objection when the work is being carried on for profit alone by the untrained under the supervision of laboratory men who are grossly ignorant of the problems concerned in orthodontic treatment. The abuses that occur by following these methods are tragic. The dismal failures which result in most cases do a gross injustice to the patients, impose an obligation on the dentist which he cannot discharge, react against his reputation and bring into disrepute the practice of orthodontia. The extraordinary bait thrown out by these concerns claiming that incomes will be materially in-

creased is only a myth, for in reality incomes are liable to be diminished, because, when failures result, the patients lose confidence and seek dental service elsewhere. They may be deceived for a time, but ultimately the truth will prevail. A philosopher said, "You can fool some of the people all of the time; part of the people some of the time; but you can't fool all of the people all of the time." My father used to say to me, "Never give advice unless it is asked for and then sparingly," but I should be remiss in my duty if I did not offer a few words after an experience of many years in this work. Let us not undertake orthodontic procedures without being familiar with this field and without being capable of doing the work on our own resources. Otherwise, we are likely to find ourselves in an embarrassing and compromising position, out of which extrication will be most difficult.

CONCLUSION

1. The art and science of orthodontia is highly specialized. Its present status has been the result of the efforts of a large group of men who have devoted much time to the solution of its problems. Its practice is based upon scientific facts, the knowledge of which is necessary in the successful treatment of malocclusion.

2. The responsibility of the dentist lies more specifically in the field of prevention, the correction of minor occlusal displacements and the giving of the proper orthodontic advice to his patients.

3. The obligation of the orthodontist is to render the best service of which he is capable at all times, to keep informed of the advancement in orthodontic methods and to treat only those cases by mechanical means where such procedure is clearly indicated.

4. The advertising propaganda of appliance vendors is mostly misleading and does not afford the necessary guidance in the treatment of malocclusion.

In discussing this subject I have endeavored to stress the importance of proper training before one enters the field of orthodontia. I have called attention to certain necessary requirements in the use of appliances and have warned against the danger that lies in following the advice of commercial agencies.

DISCUSSION

Charles R. Baker, Evanston, Ill.: In reply to the question "Do you think a general practitioner should treat malocclusion?" Dr. Casto answers "Yes, provided he is qualified to do so." He also states that "anyone who ventures into this field of endeavor must be qualified to render a satisfactory service." I am sure that these statements are in accord with the ideas of most orthodontists. The requirements necessary for qualification to practice orthodontia are a matter in which there is no scholastic or clinical standardization at this time except the legal requirement of a license to practice dentistry. The American Board of Orthodontia was created and is now functioning with this very purpose in view. Any dentist may apply to this board for examination and, on fulfilling the necessary requirements, will be awarded a certificate of qualification to practice orthodontia. It is generally believed that insufficient time is devoted to the teaching of orthodontia in most dental schools, with the result that the student does not realize the importance of the subject. Some dental schools allow students to graduate who have failed in orthodontia. A number of state boards of dental examiners grant licenses to applicants who fail in their examination also. These are factors in creating a very unfortunate situation and, as Dr. Casto states, the patient is the one who suffers. In my opinion, if a general practitioner intends to practice orthodontia, he should thoroughly understand the nature of the orthodontic problem, which is so well stated by James D. McCoy, as follows: "Orthodontia is a study of dental and oral development; it seeks to determine the factors which control growth processes to the end that a normal functional and anatomical relationship of

these parts may be realized, and aims to learn the influences necessary to maintain such conditions when once established." He should be well enough informed as to the normal growth of the teeth, jaws and related parts that he will be capable of recognizing abnormal development as early as possible. He should study the etiology of malocclusion and should appreciate the fact that unless the causes are eliminated, satisfactory results are not possible. He should realize that, in most cases, a number of factors may be involved in creating the deformity. Good judgment in making diagnoses and in determining the correct time for treatment are essential in orthodontic practice. A man practicing orthodontia should be familiar with the various types of appliances and should know what appliance is best suited for use in each case. He should have a knowledge of materials used and should be capable of making the appliances. An operator may have all of the qualifications mentioned so far and still may not be able to produce results satisfactory to his patients or to himself unless he has sufficient clinical skill to apply the mechanisms properly and to adjust them correctly. This requires much practice and study and can be acquired only through extensive experience. As it is quite evident from the foregoing remarks, it would, in my opinion, be somewhat presumptuous for the average general practitioner to practice orthodontia with the expectation of satisfactorily fulfilling his obligations to the patient. Dr. Casto has mentioned two types of appliances: fixed appliances, which are attached to the teeth by means of cemented anchorages, and removable appliances, which can be removed and replaced by the patient. Fixed appliances have so many advantages and are so superior to removable appliances that I cannot recommend the latter, regardless of the attractive advertisements seen in our journals. I have never seen a single case treated with removable appliances in which satisfactory progress was being made, but I have observed many cases in which disastrous results had been produced in the matter of position and relation of teeth, injury to the soft tissues and caries of the enamel. Many dentists send models of one or both dental arches to a supply house and are willing to use the appliances selected by a clerk who has no knowledge of orthodontia. Others prefer to have a laboratory mechanic design and make the appliances. The misuse of orthodontic appliances is not confined to their selection and manufacture. Most of the abuse occurs in the operation of the appliances. The following conditions were present in some cases that I have seen which had been treated by incompetent operators: anchor bands poorly fitting; too large; impinging on the peridental membrane; interfering with occlusion; having sharp or rough occlusal margins; improper location and direction of buccal and lingual tubes or other attachments; labial arch wires improperly shaped as to relation with individual teeth, gums, lips and cheeks; with much more buccal pressure than should be used—in one case, both upper first molars were moved so far buccally in four weeks that they were entirely out of occlusal contact with the lower teeth; lingual arch wires improperly fitted; lack of stability of attachment to anchor bands; inefficient finger springs incorrectly located; ligatures causing pressure on the peridental membrane; sharp ends of wire ligatures irritating lips and cheeks; silk ligatures in contact with tooth enamel, inducing caries. The lack of a good technic is frequently evident in the use of spurs, hooks and other auxiliary parts. Anchor teeth are sometimes unintentionally rotated or tipped. The use of rubber bands by orthodontists is generally confined to intermaxillary pressure, but the novice often applies them for individual tooth movement. Less than two weeks ago, a case was called to my attention in which a dentist placed a rubber band over two teeth in order to eliminate interdental space. Occasionally, we see rubber wedges used for tooth movement. Attempts are made to crowd teeth lingually into spaces too small to receive them. A dentist who had been treating a case for a year brought his patient to me for advice regarding further treatment. I found that the arrangement of the teeth in both arches was very good, but explained that the lower arch was the width of one cusp distal to normal in relationship to the upper arch. He exclaimed, "My word! I moved the teeth in the wrong direction—the cusps were end to end when I began treatment." The incorrect use of "wire-stretching" pliers is another abuse in orthodontia. I have seen a number of cases in which these pliers were used injudiciously

on soldered lingual arch wires, causing much undesirable tooth movement and bad displacement of anchor teeth. Quoting from a paper which I presented before the Illinois State Dental Society in 1927: "In order that orthodontic appliances may not be injurious in some measure, during the treatment of malocclusion, it is essential that the proper method of treatment be employed, that care be exercised in the selection of the type of appliance used, and that the appliance be carefully constructed, accurate as to fit, properly attached to the teeth, and skilfully adjusted. The operation of the appliance must be such that the pressure upon the teeth is correct in amount and direction, and always under control. Proper hygienic care by the operator, with genuine cooperation on the part of the patient, must be given the teeth and the appliances used." I wish to urge the gentle practitioner to study the growth and development of the lower half of the face and I would suggest that he read carefully in the dental literature the contributions on this subject of T. Wingate Todd and Milo Hellman. The writings of R. C. Willett on the prevention and interception of malocclusion should also be an inspiration to every person interested in child health and normal development.

VINCENT'S INFECTION—ACUTE, SUBACUTE, AND CHRONIC*

By S. LEONARD ROSENTHAL, D.D.S., Philadelphia, Pa.

VINCENT'S infection has many aliases, such as Vincent's angina, Vincent-Plaut infection, ulceromembranous stomatitis, trench mouth, necrotic stomatitis, diphtheroid angina and Gilmer's disease. The generic term "Vincent's infection" has been suggested by the Committee on Nomenclature of this Association as the most suitable designation. It may be defined as a contagious fusospirochetal infection, primarily of the mouth and throat.

In 1894, Plaut first described five cases of "angina."[1] Two years later, Vincent[2] published the first description of the micro-organisms associated with the disease which bears his name. The literature up to 1914 reveals little on the subject, which suggests that the total number of cases was small. During the World War, thousands of cases were observed, and, in the following years, the numbers have increased. Indeed, so prevalent is this disease today that at least one state has made it manditory to report cases to the health authorities.

ETIOLOGY

The predisposing causes may be divided into the systemic and the local. Under the first may be mentioned debility, avitaminosis, tuberculosis, diphtheria, severe gastro-intestinal disorders, syphilis, diseases of the blood and metallic poisoning. Vincent's infection may complicate syphilis, leukemia, agranulocytosis, purpura hemorrhagica, diphtheria and mercuric poisoning, occasionally rendering diagnosis more difficult.

*Read before the Section on Periodontia at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 13, 1932.

1. Plaut, H. K.: Studien zur Bacteriellen Diagnostik der Diphtherie und der Anginen, Deutsch. Med. Wchnschr., 1894.

2. Vincent, H.: Etiologie et Lesions de la Pourriture d'hopital, Ann. l'inst. Pasteur, 1896.

Local predisposing causes include trauma, the presence of calculus, overhanging margins of fillings, poorly fitting crowns, poor interproximal contacts, flaps of tissue over partially erupted teeth and burns; excessive use of alcohol, tobacco and spices, and periodontoclasia.

The disease is contagious and may be contracted by direct contact with the mouth of an infected person or indirectly by the use of insufficiently cleansed eating utensils etc. There is also the possibility of auto-inoculation. It must be borne in mind that the etiologic organisms are natural inhabitants of the

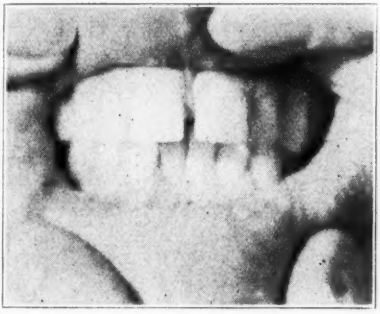

Fig. 1.—Normal mouth.

oral cavity, developing in inaccessible places and in débris where the oxygen supply is low. They are normally harmless saprophytes. Should gingivae of low resistance be pierced by a toothbrush bristle, for example, and some of these organisms be introduced beneath the surface, they may be placed in an environment favorable to their growth, thus becoming parasites.

BACTERIOLOGY

The direct cause of this infection is generally accepted to be a parasitic invasion of *Bacillus fusiformis* and *Spirochaeta vincenti* living in symbiosis. The bacillus is a straight or slightly curved rod from 1.5 to 4 by from 3 to 10 microns, with pointed ends showing from two to six granules. It is nonmotile, gram variable and anaerobic. The spirochete is anaerobic and motile, measuring 0.3 by from 12 to 25 microns with four or five spirals. It may be differentiated from *Spirochaeta pallida* of syphilis by the fact that *Spirochaeta vincenti* moves with a lashing motion, while *Spirochaeta pallida* has a corkscrew motion and has from fifteen to twenty spirals.

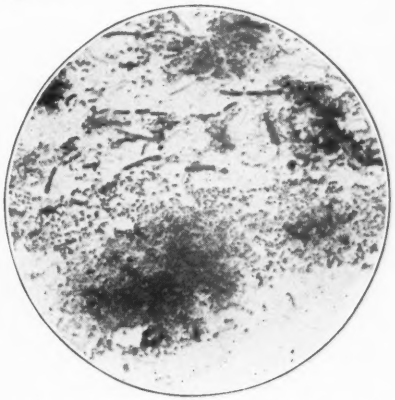

Fig. 2.—Smear from mouth shown in Figure 1. A few spirochetes are present.

In the symbiotic state, Vincent's organisms are facultative anaerobes, and are extremely difficult to grow on artificial mediums. They do not satisfy Koch's postulates. It may be that a suitable animal for transference has not yet been found. Dogs and cats have been suggested for this purpose. Smears from and one attempted transfer to dogs have been negative in my hands.

Vincent's infection does not bring about the usual body defense mechanism. There is no phagocytosis and no immunity to subsequent attacks.

A section through an infected area shows tissue necrosis with no immediate inflammatory reaction. The cells stain badly: the nuclei are indistinct, and surrounding this area is a proliferation of cells. Beyond is a slight round-cell infiltration, principally of mononuclear cells. The bacilli extend through the necrosed and partially destroyed tissue. The spirochetes, far in advance, penetrate the intercellular spaces.

The process destroys first the interproximal papillae, then the alveolar crest, and spreads widely and deeply to adjacent parts.

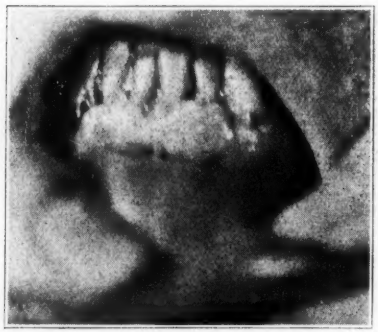

Fig. 3.—Acute primary Vincent's infection.

CLASSIFICATION

Vincent's infection presents three distinct types: 1. Primary Vincent's infection, an infection of the superficial structures of the mouth or throat, which may be subdivided into (*a*) acute, (*b*) subacute and (*c*) chronic. 2. Secondary Vincent's infection, an infection of the deeper structures of the mouth or throat, e.g., bone. This is always acute. 3. Tertiary Vincent's infection, an invasion of other parts of the body, e.g., lungs. This type too is always acute.

SYMPTOMATOLOGY

Acute Primary Infection (Fig. 3).—The first manifestation of this type is a red, tender spot on the gingivae, which bleeds readily. The process increases in area and severity. Gnawing pain, increased salivation and a characteristic fetor develop. The lesions consist of dirty gray or yellow patches surrounded by red or purple tissues. The membrane is easily removed, leaving a raw, bleeding surface. There is no pus. The parts are acutely sensitive and bleed readily. The interproximal papillae in the involved areas are destroyed. The teeth become slightly loose. As the throat becomes involved, deglutition becomes painful.

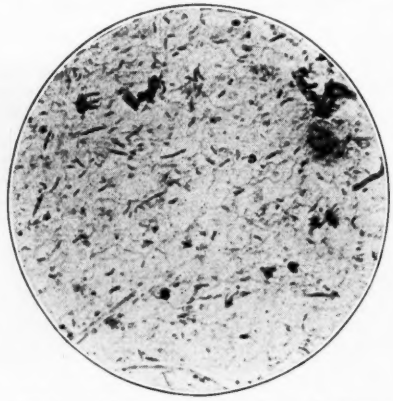

Fig. 4.—Smear from case shown in Figure 3. There is a preponderance of the etiologic organisms.

A general feeling of lassitude and depression arises owing to absorption of toxins, accompanied by anorexia and constipation. There is some adenopathy together with an increase in pulse rate, respiration and temperature, the latter averaging from 99 to 100 F. This condition may develop into secondary Vincent's infection.

Subacute Primary Infection (Fig. 6).—There is no ulceration in this type of infection. Instead of the punched out

appearance of the acute lesion, there is a puffy swelling of the tissues, which have a red or purplish hue. The parts are painful and bleed readily. The symptoms are less severe than in the acute type, but the condition may develop into the acute.

Chronic Primary Infection (Fig. 9).—This type of Vincent's infection is painless. It closely resembles periodontoclasia or a gingivitis which will not respond to the usual treatments.

Fig. 5.—Roentgenogram of case shown in Figure 3; destruction of bone.

Fig. 6.—Subacute primary Vincent's infection.

Secondary Infection.—This differs clinically from primary Vincent's infection only in the severity of the symptoms. The feeling of malaise becomes prostration, necessitating confinement to bed. Painful opening of the mouth, from which saliva drools, reveals large areas of foul-smelling necrotic tissue. The teeth are loose and may be devitalized and abscessed as the result of the destruction of the periodontal structures. The gingivae are swollen masses of dark red tissue. The lymph nodes too are swollen and painful. There is a temperature rise to from 101 to 103 F. or higher, accompanied by the symptoms of a severe toxemia.

In the most severe cases, the temperature rises dangerously high. The cervical lymph nodes swell until the face has a grotesque appearance. Pulse and respiration are rapid, but feeble and shallow. Both erythrocyte and leukocyte counts drop. The patient becomes drowsy, then comatose, and steadily sinks into death.

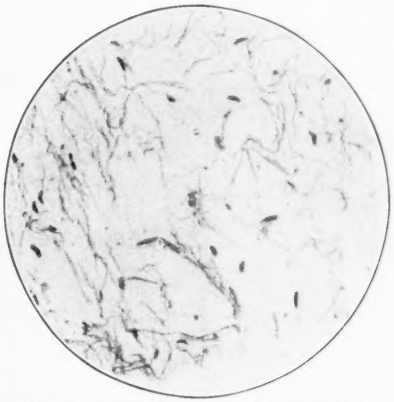

Fig. 7.—Smear from case shown in Figure 6.

Tertiary Infection.—There can be no symptomatology given for this type of the infection, since the picture naturally varies with the part involved.

The most common point of attack is the lungs, pulmonary gangrene, usually a fatal complication, resulting. In 1929, the last year for which the figures are available, there were 223 deaths in the

United States from this cause. It has been shown repeatedly that the etiologic organisms have been inspired from the oral cavity.[3]

Some years ago, Hunter severely criticized the dental profession for practices then common. The hunterian indictment was a true bill. A Hunter is again needed to forcefully point out to the medical as well as to the dental profession the danger of administering a general anesthetic (irrespective of the parts to be operated on) in even mild cases of Vincent's infection; and to give impetus to more thorough oral examination in all institutions employing general anesthesia.

Vincent's infection must be differentiated from diphtheria, erysipelas, thrush, syphilis, the various forms of gingivitis and stomatitis, certain childhood diseases, infection by a fungus and periodontoclasia. There can be little confusion if microscopic examination is employed. Indeed, the microscope is essential for guidance in treatment as well as for diagnosis.

A quick and convenient method of preparing smears follows: The material is collected by gently rubbing a sterile platinum loop, swab, curette or excavator over the parts. Transfer is made in a broad, thin smear to a glass slide which has previously been washed clean, dried and flamed. The material is allowed to dry; then fixed by quick passing of the slide three times through a Bunsen flame. Sufficient of a 2 per cent aqueous solution of gentian violet is added to cover the film completely. This is washed off in fifteen seconds with tap water and blotted dry. A drop of cedar oil is added and the result viewed with an oil immersion objective. The entire procedure requires about two minutes.

The mere presence of a few Vincent's organisms is not sufficient to call the smear positive for Vincent's infection. Positive slides require no searching—field after field literally swarms with the etiologic organisms. (Figs. 4, 7, 10.) Smears from chronic Vincent's infection, in contrast

Fig. 8.—Roentgenogram of case shown in Figure 6.

Noma is a rapidly progressive gangrene of the face more frequently seen in very young, debilitated subjects. It is a form of Vincent's infection with a very high mortality. The infection first attacks the mucous membrane of the cheek, from which point it spreads to the skin by perforation and thence over the face.

Vincent's infection has been reported also affecting the fingers, conjunctiva, ear, nose, sinuses, vermiform appendix, genitalia and central nervous system.

DIAGNOSIS

Diagnosis is made from the appearance of the tissues and microscopic examination of smears from the parts.

3. Smith, D. T.: Fusospirochetal Diseases of Lungs, Tubercle, 9:420-437 (June) 1928.

to acute, appear to show no leukocytes. (Figs. 4, 10.) I present this as a thought rather than a fact. Further investigation is required.

Chronic cases may require several smears before the site of the infection is found. One should be suspicious of a gingivitis which fails to respond to the usual treatments.

PROGNOSIS

The prognosis is usually favorable. In the acute forms, much depends on the resulting toxemia. Death has followed severe infection.

In children, the disease is usually severe and accompanied by high fever. The onset is rapid and the recovery equally so as a rule, but the possibility of noma as a complication should never be overlooked.

Fig. 9.—Chronic primary Vincent's infection.

There may be pulmonary or cerebrospinal complications. Cases of long duration result in a destruction of the alveolar crest (Figs. 5, 8, 11) and periodontal complications. The disease tends to recur.

The question as to whether the physician or the dentist should treat this disease is often discussed. It seems but reasonable that the nose-and-throat specialist is best equipped to care for pathologic conditions in these regions; that the dentist should treat the mouth, and that toxemia and disease of other parts should be under the jurisdiction of the general medical practitioner.

It must be borne in mind that disease processes are not limited by imaginary lines. The fact that no case of Vincent's infection has been recorded in the edentulous (except immediately after extraction in the presence of the disease) would indicate that the periodontium may play an important rôle in these processes; and since immunity does not follow recovery, dental hygiene must guard against recurrence. It would, then, seem to be in the best interests of the patient to have dental consultation irrespective of the parts involved.

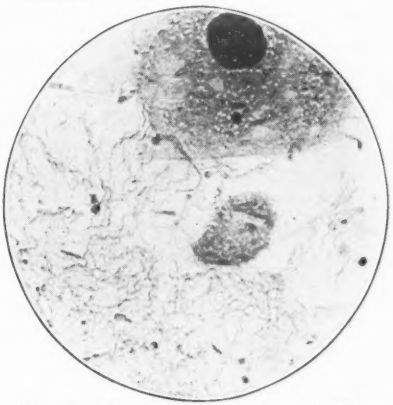

Fig. 10.—Smear from case shown in Figure 9. The large body with a circular nucleus seen at the top of the field is a squamous epithelial cell. A leukocyte is near the center.

TREATMENT

The drugs which have been advocated for treatment are legion. The rationale of scientific treatment gives two methods of choice: 1. Topical application of oxygen-liberating compounds in order to inhibit the growth of the anaerobic organisms. 2. Topical and intravenous use of spirocheticides.

The great confidence in solutions of chromic acid is, in my opinion, misplaced. If we inquire into the pharmacology of this drug, we find that it is an oxidizer

and a caustic, precipitating albumin. Application of chromic acid must in some measure cause a necrosis of the surface tissue which, in turn, is an excellent pabulum for the very organisms that we are trying to eliminate. Furthermore, acid solutions have no place in the treatment of Vincent's infection, and, finally, more efficient oxidizers are at our disposal. I do not wish to imply that chromic acid will not bring results eventually, but rather that it unnecessarily prolongs the period of treatment.

A spirited controversy has arisen over the intravenous administration of arsphenamin. The argument is ofttimes presented that syphilitics undergoing this therapy frequently develop Vincent's infection, thus demonstrating the impotency of this method. Such a statement completely overlooks the question of drug tolerance. It would be as logical to suppose that because the patient still suffers from syphilis, the drug is useless for this disease also. When intelligently used, injection of arsphenamin has brought speedier relief than any other method at our disposal for acute cases.

It is poor judgment to employ arsphenamin if the patient has already been subjected to its influence. Bismuth or the newer spirocheticides are more likely to succeed in such cases; and it is well to change the drug occasionally if improvement is slow.

The first step in successful treatment is correct diagnosis. This includes the proper classification of the case in hand.

Acute and Subacute Primary Infection.—At the first visit, the salivary glands are blocked off with cotton rolls and the saliva ejecter, and a 5 per cent solution of arsphenamin base in glucose is applied with glass applicators. It is well to apply the solution liberally to the entire gingival tissue whether diseased or healthy. The parts are kept moistened with the drug for fifteen minutes, freedom from saliva being essential. A 2.5 per cent aqueous solution of bismuth sodium tartrate[4] may be substituted for or alternated with the arsphenamin, or a thick paste of sodium perborate and water may be used. The latter is not so efficacious in the majority of cases. Intravenous medication is seldom necessary.

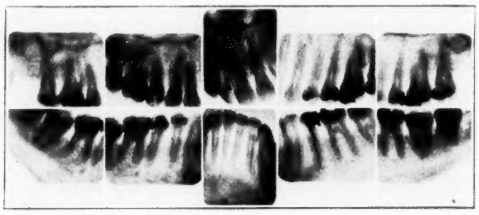

Fig. 11.—Roentgenogram from case shown in Figure 9.

The patient is then dismissed with these instructions: 1. Absolute prohibition of alcohol, tobacco, spices and acid fruits. 2. The use of a diet of milk, broth, eggs, chicken, fish, raw and cooked leafy vegetables and 8 ounces of orange juice a day. 3. The use of a mouth wash of sodium perborate, 1 ounce, with water to make 4 ounces (freshly prepared). (Continued use of sodium perborate nauseates some patients. In such cases,

4. This product has not been submitted to the Council on Dental Therapeutics.

one of the many aromatic products may be prescribed.) 4. The use of a mild saline cathartic. 5. Acetyl salicylic acid therapy for pain. 6. Application of external heat for a half hour for swollen glands. 7. The use of separate eating utensils, which are to be boiled after using. Warning is given against kissing or otherwise spreading the disease.

The treatment is repeated until tenderness has disappeared, when prophylactic measures are taken also. Up to this point, we have been fighting the infection itself. The corrective procedures must eliminate the cause as otherwise recurrence will surely follow. The teeth are thoroughly scaled and polished, and overhanging filling margins, etc., are corrected. No surgery or extractions should be attempted until all symptoms have subsided and several smears have been negative. Premature extraction may spread the infection into the bone, resulting in a secondary Vincent's infection.

The toothbrushes used before and during treatment should be destroyed.

The majority of cases require additional treatment for periodontoclasia. At the conclusion of all treatment, the patient should be fully instructed in the care of the mouth, and the fact stressed that neglect will in all likelihood result in a recurrence of the infection. Daily gingival massage with the fingers is an excellent method of gaining tissue tone.

The mouth should be kept free from irritating deposits by prophylactic treatments at short intervals after completion of treatment. The intervals may be gradually increased.

Chronic Primary Infection.—Treatment differs slightly from that of the acute forms. A rigorous scaling is initiated at the first visit followed immediately by thorough bathing of the parts in arsphenamin base or bismuth sodium tartrate. Home care is similar to that used in the acute cases.

Considerably more difficulty is encountered in overcoming chronic Vincent's infection than in combating the acute forms. The acute and subacute types average from two to four visits before obtaining a negative smear; the chronic, from four to seven. The latter is more likely to recur.

Secondary Infection.—These cases are properly hospitalized because of the toxemia and possible complications. Certainly the patient will be confined to bed, and it is advisable to have medical consultation. The treatment is similar to that of acute primary Vincent's infection with certain additions: An intravenous injection of arsphenamin should be given by a qualified physician; 2 per cent aluminum subacetate compresses may be applied to reduce the swollen glands; abscessed teeth should be drained through the root canal, and systemic disturbances are treated appropriately.

Tertiary Infection.—Treatment varies according to the site of lesions. The basic principles are the same: intravenous, and, where possible, local administration of arsphenamin or the intramuscular use of bismuth. Irrespective of the parts involved, the oral cavity should not be overlooked.

Some years ago, I stated that Vincent's infection was entirely an acute process.[5] Observation of many hundreds of cases and records of colleagues revealed no instance of chronic infection as we understand it today. At that time, the sodium perborate treatment of Bloodgood was most effective.[6]

5. Rosenthal, S. L.: Outline and Classification of Vincent's Infection, D. Cosmos, 71:890 (Sept.) 1929.

6. Bloodgood, J. C.: Oral Lesions Due to Vincent's Angina, J.A.M.A., 88:1142 (April 9) 1927.

Today, more than 60 per cent of my cases are subacute or chronic. Treatment exclusively with sodium perborate is slow and generally unsatisfactory.

What is the significance of these facts? Have the characteristics of the etiologic micro-organisms changed with respect to oxygen tension? Is transference from man to man lessening the virulence of these parasites? and, if so, can we look forward to eventual freedom from this disease? These are a few of the unsolved questions concerning Vincent's infection.

Medical Arts Building.

PRACTICAL DENTURE CONSTRUCTION*

By C. O. FLAGSTAD, D.D.S., Minneapolis, Minn.

THE emphasis which has been placed on the importance of impressions, bites and articulation in denture service in recent years has resulted in great improvement in denture construction, for out of this concentration has come the standardization and development to the minutest detail of the technic of impression taking; the production of many scientific methods and instruments for accurately establishing the proper relation of the jaws, and the manufacture of a great variety of articulators, each machine having as its specific merit the possibility of producing accurately balanced dentures. The profession has almost come to believe that if a technic can be mastered which will afford perfect impressions and a scientifically balanced occlusion, most of the difficulties associated with plate making will be solved.

We have become so interested in using, producing and discussing machines of precision and in mastering technics that we have frequently lost sight of our subject—the patient. We have, it seems, adopted the theory that scientifically constructed dentures should always function efficiently in all mouths, provided a prescribed technic has been properly carried out. We therefore strive to perfect ourselves in somebody's technic, believing its universal application will bring universal success. While this system develops skill and therefore has merit, it has a tendency to limit one's vision to technical procedure and not stimulate observation of the patient. The profession, with few exceptions, neglects to study and observe denture patients for the purpose of gathering knowledge which might be of assistance in future denture construction. As a result, many failures are misinterpreted, being charged to faulty technic or impossible patients; whereas, these failures might be prevented, provided observation was made of patients who successfully wear plates and profit derived from the lessons such study afforded; i.e., that all technics must be subject to variation to suit individual conditions and needs.

It is not my purpose to minimize the importance of impressions, bites and ar-

*Read before the Section on Full Denture Prosthesis at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 13, 1932.

ticulation, but I wish to direct attention to a factor in the successful wearing of full dentures that equals or even transcends in importance these other factors; for I am positive that the permanent retention of dentures and their successful use with comfort over a long period of years does not depend so much on the physical retention relation (referring to atmospheric pressure and adhesion) as it does on the adaptations made by the patient to the presence and use of plates.

Perhaps I can prove these contentions by recalling two facts. First, tissue continually changes, especially under pressure, so that the sealing of dentures in most cases is very temporary. A plate made today will, five years from today, have operating very few of the factors that originally gave it retention, although the majority of patients wear the same dentures a long time, and readily testify to the efficiency of the service that they render. It therefore seems that some adjustments must have taken place to assist the patient to retain and to use these plates with comfort. The second fact is that articulation does not function as a retaining agent during most of the heaviest mastication. How can articulation function when we bite into an apple, or a steak or almost any other kind of food? How can articulation function as a retaining agent when there is a large bolus of tough food between the teeth on one or both sides to be crushed? It is obvious that articulation does not function during these acts as the teeth are far out of contact. In fact, before articulation operates materially, the food must be reduced to comparatively minute particles. What, then, makes it possible for the patient to retain the plates while he successfully reduces his food? In the average mouth, after a patient has worn the same dentures a long time, the physical retention (suction and adhesion) remaining is not sufficient to retain the plates under the stress of mastication without the aid of adjustments on the part of the patient and the tissue of the mouth to support the dentures.

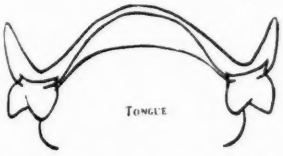

Fig. 1.—Position tongue assumes when stress is applied to anterior teeth of denture. The tongue "bunches" and spreads into a flattened ball supporting the denture on the posterior portion of the palate. The support given the plate is in direct proportion to the stress applied. The tongue begins by giving support on the lateral sides of the palate and spreads toward the center as the stress increases until, under a maximum strain, it will hug the palate so that dislodgement of the plate is almost impossible.

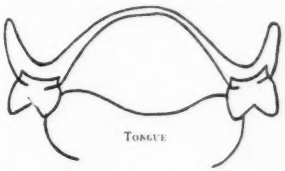

Fig. 2.—Raising and contortions of tongue to support denture under light strain. This is the type of support given an upper denture during the acts of speaking and singing.

Since these facts of adjustment and adaptability of the patient are of such importance, let us forget for the moment scientific technics and machines and focus attention entirely on the patient who is wearing dentures. Although there has been considerable written regarding the study of tissues in the mouth prior to the placing of dentures, for the purpose of securing a basis for judging

possible results, nothing concrete is recorded concerning adjustments and adaptations made by the patient and tissues after plates have been placed and worn. In my opinion, the knowledge secured from studying the patient, the mouth and the functional activities within the oral cavity after plates have been inserted will be of more value in solving denture difficulties than any other phase of full denture service that we might study. In close observation of patients who use dentures successfully, we are surprised to note what lessons can be learned as to how dentures should be constructed. Soon we discover a criterion for judging the possibility of success in remaking dentures for those who have been unsuccessful in using them.

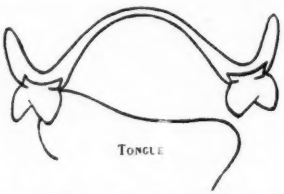

Fig. 3.—Lateral support given one side of denture when other is functioning.

Perhaps a short résumé of years of observation and experience on the subject of adaptability of patients to dentures and conditions that affect this adaptability may stimulate our observations. Years ago, when I first began teaching, I was astonished at the manner in which people adapted themselves to plate wearing. I saw cases in which all semblance of the original physical retention had long ago disappeared; in which patients were successfully wearing plates of the most unscientific construction; in which plates were being worn after they were broken in two; in which in upper dentures teeth for retention had been lost and the patient still wore the plates successfully, and in which lower dentures were simply floating. I am sure we have all had this experience.

These observations set me thinking "How do they do it?" and, since these early days, I have been trying to find the answer to this question. We usually dismiss the question by, "Oh, they learn how" or "They become accustomed to them." But this answer is not of any value in gaining knowledge. We should be interested in knowing how they learn; what adjustments occur, and why some never learn. Hence, I have endeavored to collect some of this information, believing it to have a tremendous bearing on how we construct our dentures.

I have had occasion to observe thousands of denture patients and every one has afforded an opportunity to study the manipulation of his plates. Hundreds of hours have been spent listening to patients relate their denture experiences. I enjoy observing denture patients operate their plates and I watch them in the clinic chair, whenever and wherever I engage one in conversation, and I observe denture patients engaged in singing or eating. The public speaker especially whom I know or discover wears plates affords me a fascinating study. I recommend this procedure, for it will suggest how they retain their plates while carrying on these functional activities.

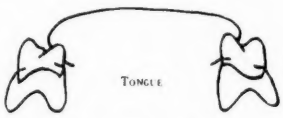

Fig. 4.—Manner in which great majority of lower plates are successfully worn. The tongue rides over the lower plate and, when strain is applied, spreads, thereby protecting the plate from dislodgement.

It is apparent, from my observation, that the successful user of plates overcomes habits that tend to dislodge dentures and builds up a system of habits that will help retain them. The muscles of the cheeks, lips and especially the tongue become stabilizers. The contortions of the tongue in its endeavors to support dentures are amazing. Every functional activity, such as eating and speaking, tends to adjust itself to such a degree as to protect the dentures from dislodgement.

Therefore, a knowledge as to how the tissues adjust themselves and how they support the plate, and what limitations can be put on functional activity, is important in order that we may take these facts into consideration in building our dentures. A denture may be so constructed as to make adaptability by the patient easy, difficult or impossible. Plates may be constructed ever so scientifically—with perfect impression, bite and articulation—and yet not satisfy the factor of adaptability.

The accompanying illustrations show how dentures are supported and retained in the great majority of mouths during functional activity.

My conclusions are that: 1. All successful users of plates to a greater or less degree unconsciously develop this type of denture support.

2. A great many patients who do not succeed in efficiently wearing plates for some reason or other do not develop these habits.

Perhaps it is possible to visualize from these illustrations just how varying the construction of dentures as regards length of bites and position of teeth might have some bearing on the ease with which patients develop these desirable, in fact necessary, habits of retaining their dentures.

We shall consider these items a little later, but first I desire to discuss another factor which figures largely in determining the readiness with which patients become adjusted to plates. I refer to the amount of time which elapses between the extraction of teeth and the insertion of plates. The profession generally seems rather uncertain as to what instructions to give a prospective denture patient in this matter. It is now the consensus of opinion of the majority of prosthodontists that it is very unwise to permit patients to go without teeth for a number of months after extraction.

There are four definite reasons that this practice should be discouraged:

Fig. 5.—Tongue support given dentures as pressure is applied in endeavor to dislodge them.

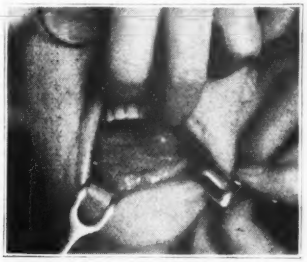

Fig. 6.—Tongue support of upper denture when stress is applied to anterior teeth.

1. The muscles of mastication and expression lose their normal tone owing to the fact that they do not function materially or they work at different levels. As is a tendency of human tissue to adjust itself to new conditions, the muscles begin to develop so as to handle the abnormality that has arisen with the loss of teeth. The patient, if permitted to go without the teeth a long time, must subsequently break down the abnormal adjustments that have taken place and develop a different muscle tone. Furthermore, the tongue expands and lips and cheeks drop in and become difficult to keep in space provided by the plate. 2. New habits develop as the patient's desire to masticate his food forces him into a new variety of relationships of the jaws. This accounts for the difficulty in later establishing central occlusion. I have further observed that people whose jaws are in function open the mouth just to a point necessary to perform the act. Therefore, since it is not necessary to open so wide when the teeth are out, this becomes a natural level and is increasingly difficult to have changed. 3. It is now generally conceded that jaws are better preserved and resorption takes place more evenly and gives a more desirable ridge, if plates are placed over fresh extraction areas rather than resorption being permitted to take place without this protection. 4. In learning to use plates a patient's pride is a driving force of which we should take advantage in denture construction. Permit a patient to go without teeth and his pride diminishes. It has undoubtedly been your experience to hear a patient say before extraction, "Doctor, how in the world will I get along without teeth? Why, I wouldn't dare go outside!" But often when we have taken these teeth out and suggested that the patient return in a month for the construction of the dentures, he has not returned but phoned instead saying, "Doctor, I don't mind going without teeth now. I've decided to let my gums heal thoroughly and I'll be in in three months." We thus have lost the assistance of a mighty compelling force —pride. The longer patients wait, the more difficult the adjustment, and the less the tolerance and perseverance, as their pride is no longer so keen and they have learned to get along after a fashion without teeth. It is better to persuade

Fig. 7.—Tongue support to lower denture as stress is applied to anterior teeth. The response of the tongue is instantaneous, in the nature of a reflex action. The patient is unconscious of performing these tongue actions.

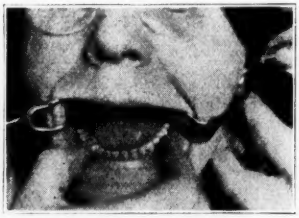

Fig. 8.—Unsatisfactory denture in position in patient who could not wear lower denture and for whom teeth were reset to lower level, with very satisfactory result. The level of the tongue in relation to the occlusal surfaces of the lower teeth is to be noted here.

patients to have dentures made soon after extraction, rebasing or remaking the plates later. There are various types and methods of rendering immediate denture service. Summarizing: The four reasons for making dentures soon after extraction are: 1. Loss of normal muscle tone is prevented. 2. A normal relation of the jaws is more easily established. 3. The ridges are better preserved under the dentures. 4. Advantage is taken of the patient's pride, which is a compelling force to persistency.

Opening and closing of the bite affects adaptability. The opening of a bite much beyond what it is at the time the teeth are lost or what has become more or less normal over years of wearing

Fig. 9.—Case shown in Figure 8. The new denture immediately on insertion; showing level of tongue in relation to occlusal surface of teeth.

dentures is usually attended with difficulty. It requires a complete new adjustment on the part of the patient. The muscles have adjusted themselves to the existing bite, and unless the patient can appreciate that it is a remedial measure for other ills, he will probably find it more convenient to complain or not use the dentures. When he has worn dentures over a long period of time, we often have a desire to make a considerable opening in the new dentures in order to assure a better appearance. Approach this procedure cautiously and open in successive steps a short distance at a time, remembering that this patient has built up a system of habits to retain these teeth, and a longer bite interferes with functional activity. Merely changing the palatal contour of plates becomes extremely noticeable and often very irritating. The patient has learned to put his tongue in certain positions to balance the plate in chewing; he operates his tongue at a certain level to speak and he opens his mouth to a certain extent to receive food. Interfere with these functions by a radical change and you have invited trouble.

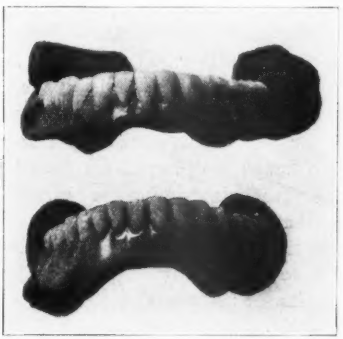

Fig. 10.—Case shown in Figures 8-9; illustrating variation in height of teeth in two dentures. Above, new denture.

I realize in discussing the matter of establishing bites that there are a great many factors to take into consideration. The research work done by a group of conscientious men has demonstrated that there are many evils to consider which follow in the wake of "closed bites." I am interested in presenting facts as I have observed them. It is my conviction that what is considered "an ideal norm" is not a norm for all ages and conditions. The very fact that these dentures, as has been illustrated, depend largely on the

tongue and tissue of the mouth for retention under stress would indicate that, for practical purposes, a variation from the "norm" might be necessary. The age at which people are reduced to dentures, the condition preceding the final loss of the teeth or the bite present in the old dentures, if a new denture is being made, seem to me paramount considerations. I would say that the length of bite established is variable rather than constant. It is frequently a compromise on what is considered a good healthy norm. Do not think that I advocate closing bites; I certainly do not. We must have an ideal toward which to work and, wherever possible, that is the bite which should be established. But practical denture service to me means the building of the case to suit the practical needs of the person for whom the service is being rendered.

Although an excessively closed bite will affect adaptability, we usually will not have functional interference, but will have complaints that it is impossible to secure rest for the jaw. The question of pride is also a factor, as excessively closed bites make for a poor appearance and some patients will not adapt themselves to plates that they do not like.

The level of the teeth occlusally has a marked bearing on the adaptability. When the upper teeth are hung extremely low and set far lingually of the former position of the old teeth, we have produced a condition that makes adaptability difficult. This means an extreme limitation of the forward thrust of the tongue, as the tongue, if functioning normally, will hit the teeth and perhaps dislodge the plate. The accompanying illustrations will recall how the position of teeth might affect adaptability to dentures.

The level of the lower teeth occlusally is very important. If the teeth are set too high, a severe handicap to the patient's adaptability results. Retention of a lower denture is usually not physical but rather the result of adaptation on the part of the patient. The lower plate is usually held in position by being enveloped by the tongue and muscle of the lip and cheek. If the teeth are set to an abnormal level in height, it becomes impossible for the tongue to rise above them and rest there comfortably; consequently, the tongue, instead of acting as the stabilizer, becomes the means of dislodging the plate. We find in observation that, in speaking, successful denture patients usually operate the tongue above the occlusal level and incisal edges of the lower teeth. Therefore, if the teeth are so set that it is impossible to do this, the plate will be dislodged in the act of speaking.

We have reset many lower dentures sometimes on the old base, with marked success, simply by changing the occlusal height of the teeth.

Patients have frequently stated their difficulties in the following words: "I can't open my mouth wide enough to receive the food." "My teeth hit too soon." "The lower teeth are too high." "I can't get the spoon over the lower teeth to put the food into my mouth." "My teeth clatter when I talk."

A certain percentage of patients will be able to make necessary adjustments, but many of them we make very unhappy and finally disgusted by forcing them to the limit of their endurance.

The practice of dentistry is enjoyable in proportion to the happiness and comfort that we can give our patients. Many of the difficulties of denture service can be eliminated if we observe how people adapt themselves to manipulating den-

tures and then endeavor to bear these facts in mind.

Close observation of denture patients will teach us more as to what constitutes practical denture service than any information that could possibly be given us.

DISCUSSION

Francis Scott Weir, New York City: The subject of practical denture construction has become as relatively a part of any full denture program as the tariff issue of the major political party platforms. When subjects are assigned, "practical denture construction" always wins a supporter. It would be interesting to assemble all the papers under this title for comparison. The result would undoubtedly yield many surprises and one might wonder how such a divergence of opinion could in each instance produce practical dentures. Lack of definiteness in a title may be excused on the grounds that it gives the essayist greater latitude in subject matter and also because every operator is striving to give the general practitioner a more practical procedure. Dr. Flagstad as a teacher is in a position to observe many types of cases. In addition, he is dependent on inexperienced operators in the college, which necessitates the development of a practical technic if any approach to satisfactory results is to be attained. Dr. Flagstad is quite right in urging a closer study of the patient. While it is true that a technic of procedure is necessary, it is also true that the technic should be made to fit the patient and not the patient the technic. Entirely too much emphasis has been placed on methods and too little thought given to learning why a denture functions or fails. Many operators have become "takers." They take a course of technical procedure from one instructor, and before they have mastered this, a new course is taken and later another, so that, in a short time, they have four or five procedures and cannot efficiently manipulate any one of them. The course should be taken to learn why a denture is successful; what may be considered a well fitted base for the particular ridge; what tooth position accounts for tongue room and enhances the appearance, and what leverage, both vertical and horizontal and facial dimensional makes for power of muscle action. The technical procedure is simple once it is understood what constitutes a successful denture, and any one of the recognized methods may be employed and modified to fit the particular patient. The one point that I desire to emphasize is the height of the lower denture. Invariably, operators build lower dentures too high. The tongue is put in a straight jacket thereby and its support to the denture is lost, and food control and speech are difficult. Also, undue leverage is placed upon the denture, causing it to tip. The occlusal surfaces of the bicuspids and molars should be at least as low as the dorsal surface of the tongue when at rest, and usually the tongue is from 2 to 3 mm. higher than these posterior teeth. Each case, of course, varies in this position. Study of natural dentitions as to these relationships will teach us many interesting things. Dr. Flagstad's paper is the foundation of a most important truth and I have learned something from a study of it. It is commended to your consideration.

Walter F. Chappelle, Buffalo, N. Y.: This paper stresses certain phases of dentistry often neglected on dental programs. The key to its whole message is: "Practical denture service means to me the building of the case to suit the practical needs of the individual for whom the service is being rendered." It is the practical application of any technic, based upon intelligent observation, that gives it its real value. There is no time to dwell upon all the valuable points of this paper, but it is well to emphasize a few, such as the temporary character of the mouth conditions influencing the retention, and the vertical and occlusal relation of the dentures. May I suggest that we should educate our patients, to rebasing or rebuilding at two or at least three year periods? Dr. Flagstad points out that a study of what happens after dentures are inserted would be of great value in subsequent denture service both in preparing and in coaching inexperienced patients and in building for and coaching wearers of old dentures; also, that dentures should be inserted immediately; that age and the length of time that unfavorable bite conditions have persisted should increase our caution in opening the bite excessively; that pride is a great factor in successful denture wearing; that a perfect impression, bite and articulation can still not satisfy the factor of adaptability and, what is also very im-

portant, that the tongue, cheek muscles and lips can more readily become stabilizing factors if the teeth are so placed that the shape of the arch and the length lend themselves to such action. Perhaps a statement as to the part technic and experience each play would clarify any inference that this paper might be wholly discarding technic for experience. Technic determines the type and perfection of the impression, the accuracy of centric occlusion, the degree of coordination of the occlusion and, within certain limits, the development of facial esthetics, and the counteracting of displacing bite forces. Experience determines, among many other things, the area of peripheral extension, and hard area relief to limit peripheral pull and fulcrum action, the modifying of the dictates of stability so that posterior and anterior teeth may be moved slightly up or down, anteriorly or posteriorly, lingually or buccally in consideration of esthetics or phonetics. Great ingenuity is possible in the development of arch form, arch relation, location of a plane of orientation, the occlusal plane, the overbite and overjet and the general plan of occlusal cusp planes, and this is responsible for the remarkable esthetic effects, the perfection of enunciation and the efficiency and stability which attend the work of certain full denture prosthetists. We call it the personal equation in denture service. Of the artist, we say that he puts his soul in his work. I should like to suggest a guide to determining the factor of adaptability and also the most favorable placing of the teeth as to the length of bite both of anterior and posterior teeth, the amount of overjet and the arch form. We are all familiar with the use of words such as "think," "fight" and "Mississippi," to determine freeway, but I like to use individual letters first. The letter "f," together with general esthetic appearance, is used as a value seal to determine the length and anterior-posterior position of the upper incisors. Uncomfortable bearing of their edges into the lower lip or escape of air will result from either too close or leaky positioning. The "th" sound, as in think, is used to determine whether the patient can get a comfortable edge of the tongue between the upper and lower teeth in pronouncing this word. In the pronouncing of "s" and "x," the anterior teeth start from an open position and the tongue is held so that its edge approximates the lingual incisal and occlusal edges of all the lower teeth. A quick closing movement of the jaw occurs at the instant the letter is enunciated and the tongue closes all spaces between the upper and lower teeth, allowing an instantaneous expulsion of air below the central incisors which are at that instant about 1 or 2 mm. apart, the lower incisors slightly posterior to the upper incisors. In the pronouncing of "c," the opposite, an opening movement occurs, starting from the same position as the finish of "s" and "x" and the tongue is held more closely against the upper incisal edges and dropped with the lower jaw. The value of using "c" with "s" and "x" is to check against them. Some patients will "spill" air or click the teeth more readily with one than with the other. If there is an overjet with the overbite, both opening and anterior movements will occur, and it is therefore a guide to overjet as well as overbite. In addition, since air can be spilled along, or the tongue cramped by, the posterior teeth, it is a guide both to the width of the arch and length of those teeth. There are many variations. For example, some patients who had short posterior and long anterior teeth with a long anterior overbite will hold the arches well separated and spread the tongue out between the upper and lower teeth, moving only the portion of the tongue behind the six anterior teeth. There are not so many variations that such use of phonetics is not easily mastered. Its great value lies, as I have said, in the fact that it is a guide as well to the test of the adaptability of the patients to any changes we wish to make, such as opening the bite, cutting down an undesirable overbite or excessive overjet, which otherwise would result in an excessive show of tooth material or a too complicated occlusal mechanics. Dr. Flagstad's timely paper does not minimize the importance of good technical ability, but does stress the equal importance of the practical application of such technic and experience to each individual case so that the adaptability of each patient can be readily developed to the fullest extent.

Dr. Flagstad: The use of phonetics in establishing occlusal levels of teeth is becoming very popular. Its success, I believe is largely due to the fact that it presents a practical basis for judging the length of the bite. I stated that patients open the mouth and raise the tongue to a certain

level to speak. This level is largely determined by the nature of the dentition in their mouths. It becomes fixed over a period of time as the muscles assume a tone to correspond with the functional activity required. If the dentures are placed within a reasonable length of time after the loss of teeth, the tone of the muscles and the habits persisting will, on phonetic action, determine fairly well the desirable level of the teeth. It will not necessarily be the "ideal norm" but it will be a practical norm for that particular patient. A difficulty arises when a patient has been without teeth for a long time, because, in such cases, the muscles have lost control and the tongue does not raise to a desired height in the pronunciation of words except through forced action on the part of the patient. It then becomes a matter of judgment on the part of the operator as to how far the patient can force himself to tolerate what is temporarily an abnormally high level for present functional activities until such a time as a muscle tone is developed to handle this new condition which approximates normal height.

A RATIONAL PLAN FOR COMPLETE COMMUNITY DENTAL CARE THROUGH A MOUTH HYGIENE COUNCIL*

By F. VAN MINDEN, D.D.S., Chicago, Ill.

THE Declaration of Independence holds that all men are endowed with certain unalienable rights, and "that among these are life, liberty and the pursuit of happiness." While it is not believed that the word "life" has ever been interpreted to include the meaning "health," there can be little doubt that the health of the people is recognized to be of paramount importance to the government. More than that, the attention of the government, whether it be federal, state or local, is increasingly focused on safeguarding the public's health, as the following brief résumé indicates.

The United States Public Health Service of the Treasury Department makes health examinations of all incoming travelers at quarantine stations in ports of entry. It also renders various medical and dental services to certain groups of people. The War and Navy departments look after the health of those under their jurisdiction, while the Veterans Bureau renders extensive service to war veterans for ailments and injuries, many of which are not in the least connected with military service. The Department of Agriculture maintains food and drug inspection throughout the country, to protect the public's health and to bar the sale of undesirable products.

The various state and local governments have elaborate health and welfare departments, which safeguard the health of the citizens in their respective districts, protecting them from epidemics and inspecting their food and water supply, and also care for the mentally unfit, the blind, the tuberculous and those having a contagious disease and for indigent cases.

While, at first glance, we may thus see a picture of a fairly complete governmental supervision of the public's

*Read before the Central District Dental Society of Little Rock, Ark., Dec. 8, 1932.

health, and note indications of probable extension in various directions, there is no evidence that this interest includes adequate medical and dental care of the private citizen throughout his life, which, it is maintained, the vast majority of citizens are lacking. Nevertheless, there are some economists and sociologists who profess to see the need for an extension of governmental functions, in order to make a complete medical and dental service available to all the people. Their theory is based mainly upon the argument that as the professions are completely protected by law against intrusion by unqualified outsiders, and this constitutes an absolute monopoly, which makes professional service unobtainable elsewhere, the government, in return, should be able to supply the health needs of the large numbers of citizens of modest means, who frequently may find adequate professional care beyond their financial reach. The principal remedy which they advocate is compulsory health insurance.

A detailed description of this plan would go beyond the scope of this paper, and after the many discussions that have already taken place, a reasonable acquaintance with the system may be presumed.[1] Be it sufficient to state that it depends on compulsory financial contributions of large numbers of employes, restricted within certain wage limits, and of their employers and the state. These contributions are pooled in a common fund, out of which the professional men are paid very small fees for rendering the barest necessities in the way of medical and dental services.

Such a system easily may destroy the very valuable personal relation between the professional man and his patient, and it imposes numerous arbitrary conditions and restrictions, burdensome to both the public and the professions and obnoxious to all who cherish their professional freedom and to the large masses of our population who are not ready to accept such paternalistic governmental supervision and interference. Moreover, the cost to the taxpayers of such a system is staggering, as experience in other countries has proved. What this would amount to in our country, with its politics-ridden condition and the many possibilities for corruption and waste, can only be guessed at and beggars the mathematical imagination.

Pens more capable than mine[2] have critically analyzed this plan, alien to American financial, political, social and economic conditions, and have shown its intrinsic fallacies and inherent weaknesses. As the execution of this plan would mean the complete socialization of the professions in an otherwise nonsocialistic civilization, its advisability may be justly questioned. It also may be pointed out that the sound legal basis and protection upon which our professions are founded in contradistinction to professional conditions prevailing in many foreign countries, where the system in question originated and now is in effect, may have a material bearing on the subject.

While a few men in our profession have taken a stand favoring compulsory health insurance, the profession as a whole has reacted very unfavorably to this proposal and seems keenly alive to the dangers to its economic and profes-

1. Simons, A. M., and Sinai, Nathan: Way of Health Insurance, Chicago: University of Chicago Press, 1932.

2. Ochsner, E. H.: Social Insurance, J.A.D.A., 19:168 (Jan.), 351 (Feb.), 533 (March), 705 (April), 891 (May), 1071 (June), 1263 (July), 1484 (Aug.), 1665 (Sept.), 1863 (Oct.), 2053 (Nov.), 2223 (Dec.) 1932.

sional independence such a system would entail. As an example we may quote Dr. Johnson, Past President of the A.D.A. and now Editor of THE JOURNAL, who wrote[3]:

> There has never been any plan or method or system of practice introduced that was so subversive of the best interests of dentistry as this—nothing to approach it in the way of professional disintegration and degradation. . . . Not one constructive idea will ever come from the operation of this kind of insurance dentistry, not one advance in the science and art of our calling.

IS HEALTH INSURANCE THE BEST SOLUTION?

Is an advocacy of health insurance necessarily the only or even the wisest attitude to be taken on a basis of the facts presented in the published reports?

A careful and unbiased analysis of all the factors involved and especially those pertinent to this country, must bring one to the conclusion that this is by no means the case. On the contrary, a solution can, I believe, be found that is far better adapted to the financial, political, social and economic conditions and more easily fitted into the established professional views and traditions.

Let us revert for a moment to the thesis from which the sociologists start; namely, that since the state protects the professional monopoly and bars unqualified outsiders, the public, in return, is entitled to a service supplying its health wants within its financial means. While the social justice of this attitude is not to be considered at this time, it does not follow that compulsory health insurance is the best solution to this problem.

Health insurance might be the only solution if present business conditions in this country were to continue forever leaving many millions of people permanently out of work and destitute and many other millions working at wages too small to defray the cost of health care, because, after supporting the unemployed directly and indirectly, there is scarcely enough left for the bare necessities of life. Obviously, the government would have to provide professional service of some sort to large groups of people under such circumstances. Indeed, this has occurred in many foreign countries, where such conditions usually exist.

Authoritative business opinion and that of competent economists generally holds that present conditions are not normal in this country and that a material improvement will take place. Sooner or later, recovery will set in and, with an approach toward more nearly normal times, a great deal of the demand for compulsory health insurance will disappear. Had the investigators of health insurance given more thought to the fundamental differences between social and economic conditions here and abroad and interpreted them in their true significance, their reports would have had far greater value for us, because the scientific importance of these reports would have been greatly enhanced and the conclusion that health insurance is to be established here might have been materially modified.

The alternative which has been suggested for the dental problem, namely, low-fee pay dental clinics to bring dental care to the masses who cannot afford it now,[4] involves the very objectionable features of largely increasing the number of dentist employes, usually at low salaries,[5] the impossibility of providing

3. Johnson, C. N.: Present Day Tendencies, J.A.D.A., 19:1508 (Sept.) 1932.

4. Davis, M. M.: Status of Dentistry in Our Economic System, J.A.D.A., 17:843 (May) 1930.

5. Tentative Plan for Dental Pay Clinic in Chicago. (Unpublished data.)

good dental work at fees materially lower than those already obtainable in many neighborhood practices, the intrusion of the laity and various types of corporations into dental practice, and the danger of contract practice. All these features would both decrease and interfere with the economic independence of our profession.

In presenting what is believed to be a well rounded program for community dental care, an effort has been made to utilize conditions as they normally exist in this country and to adapt the plan to them, instead of, as many social reformers would have us do, adapting the public and the profession to their plan. At no place is there a proposal for any radical change in the social, economic and professional order of things. A path of normal development and evolution has been outlined that can be followed without requiring violent changes in either professional practice or public habits.

As this plan contains some features previously suggested by other authors, of which I can mention only a few, I wish to express my gratitude to all those whose collective contributions have aided me in formulating this plan.

SEPARATION OF MEDICAL AND DENTAL PRACTICE

It must be made clear at the start that a distinct and complete differentiation should be made between medical and dental social problems and their practical solution. Medicine and dentistry are, of course, closely related, and continued cooperation, in the scientific as well as in the practical phases of the professions, will always be much needed. The daily practice of medicine differs from that of dentistry in many aspects, important to our plan. Medicine is practiced at the patient's bedside, in his home or in the hospital, in the operating room, clinic or private office, while dental practice generally consists almost exclusively of work in the private office. A physician usually deals with the relief of suffering and sickness or some emergency, many of his cases involving questions of life or death, while dental practice consists of much routine and a truly prophylactic service for healthy people, with generally few emergencies and certainly not such serious ones. If grave medical conditions are met with, large expenditures for medical, surgical, hospital and nursing services are involved, in addition to the loss of earning power of the patient; while this is seldom the case in dentistry. Such serious ailments disturb normal family relations and may disrupt the home, with attendant complications and expense; while, as a rule, no such conditions occur during dental treatment.

Moreover, it should be observed here, although it is seldom acknowledged elsewhere, that, in general, medical practice can properly consist of only one quality of service, namely, that which will get the patient well in the shortest space of time; while dental service has an infinite variety of qualities, in the choice of materials used as well as in technical methods employed, all of which have a very material bearing on the total expense involved. The very fact that we can make complete restorations in many different ways, with a corresponding difference in cost, has an immediate effect on our financial relations with the patient and, therefore, on the public's concept of our profession.

Also, we should bear in mind that large numbers of people have lost their confidence in and loyalty to the medical profession and, as a result, they follow various other healing cults, admitted by law, or none at all. The dental profession, so far, has remained happily united

and, I believe, enjoys the confidence and respect of the public as a whole. Finally, prominent physicians have observed that many people who cannot afford medical care get well just the same, and so are learning now that they can frequently get along without a physician if they have to. But this does not apply to dental service, because neither dental caries nor pyorrhea are self-limiting or self-curable.

It is well to be aware of these differences in public sentiment, which, rightly or wrongly, exist and are bound to have a profound effect on the ultimate development of the two professions. It would have strengthened the dental cause immeasurably and put us in a much less vulnerable position had dental investigators early in their official work and associations separated more completely the dental problem from the similar but by no means identical medical puzzle of providing adequate care for the masses. The dental problem, at least, is capable of a satisfactory solution.

A COMMUNITY PROBLEM

In most of the discussions and papers on this subject, the dental profession has, so far, generally assumed the sole responsibility for the dental health of the public. This is a misconception of its proper function and duty that the profession would do well to eradicate. The dental health of the public depends to a large extent on its dietary and hygienic habits. All the dentists in the world cannot instil hygienic habits in careless people, and the most the dental profession properly can do is to repair the damage after it has occurred, and to give such prophylactic service and advice as may best prevent its recurrence. To see to it that such advice is properly carried out by the population as a whole is not and cannot be our task, for this entails an amount of educational effort, publicity and organization talent and resources far beyond the scope of our profession. Such work calls for a civic undertaking in which the cooperation of parents, teachers and social and health workers, as well as professional men, is needed, and their respective talents and interests can be pooled, coordinated and utilized.

In short, this is a problem that confronts the entire community and calls for community effort. The fight for healthy teeth and mouth hygiene, for children as well as for adults, is no different from the fight against tuberculosis, cancer and heart disease, or for mental and social hygiene, each of which is being sponsored by civic organizations representing the community's interest in that particular health problem. Some of these groups are even members of national organizations devoted to their cause. All of them recognize the principle that development of the propaganda and the enormous amount of educational work required are far more than a purely professional or scientific task.

A MOUTH HYGIENE COUNCIL

It must be thus with the mouth hygiene problem, which, of course, aims at providing dental care to the entire community, starting with the child. Too long have we labored under a burden which is not justly ours alone. If nothing else, the inadequate results in providing dental care to the masses, in which we have apparently failed, should be sufficient to prove this contention. The time has arrived when it should be recognized that this problem is one in which the entire community must cooperate if a measurable degree of success is to be attained. To this end, I propose that organized dentistry take the leadership in forming in every commun-

ity a mouth hygiene council, in which all worth while civic, lay, health and professional organizations, as well as private citizens can participate, in order to improve the dental conditions.

It is best to organize a separate council for each community of any size, for its success depends on the ability of the profession and the laity to work toward a common goal, and this requires close contact and acquaintance, which is possible only with people in the same vicinity. Where cities of sufficient size are lacking, the county or even a few counties combined may serve as a unit, but by no means should territory be included that could not readily be covered by personal contact.

In the form of organization found most useful, the voting power is vested in a board of delegates consisting of representatives of the various civic and professional organizations that have a legitimate interest in mouth hygiene and that desire to join in the movement. In other words, the importance of having as members local civic organizations represented by delegates should be stressed. Various types of memberships for private individuals and professional men can be created, in accordance with the amount of their contributions, but the voting control should rest with the board of delegates.

The advantage of this arrangement lies not so much in the protection it gives the council against a small group of individual members obtaining control during some election, and thus suddenly disturbing its continuity of policy, as in the emphasis it places on the active interest and cooperation of the various component organizations. All these groups have their own membership, each more or less influential in the life of the community, and their delegates to the mouth hygiene council, becoming familiar with problems connected with the mouth hygiene movement, can be used in turn as a means of contact and as spokesmen to present the council's views and policies before their respective organizations. The educational and psychologic effect of thus having laymen expound the virtue and need for a dental program before their own groups will go far to bring about a consciousness of the benefit of and necessity for this movement in the community's mind, the advantage of which must be apparent even to the casual observer. It would be difficult to obtain such a result by other methods.

The plan for a mouth hygiene council is no innovation, for such an organization has been in existence in Chicago and Philadelphia for some time. Having been in a measure instrumental in the conception and fulfilment of this ideal in Chicago,[6] I have had ample opportunity to observe the soundness and practicability of this plan; for, in a few months' time, we had succeeded in obtaining the endorsement and membership of a dozen large and small civic organizations, representing in the aggregate well over 100,000 members. I am satisfied that, if not hampered by civic or dental politics, such a mouth hygiene council will bear fruit in direct proportion to the amount of faithful, honest effort, energy and cooperation that is put into it.

Experience has confirmed these views and the success that has followed the efforts of the mouth hygiene council in Chicago during the last two years, acting in conjunction with the Chicago Dental Society, in obtaining and maintaining a school dental service by the

6. Partridge, B. S.: Chicago Mouth Hygiene Council, editorial, Bull. Chicago D. Soc., 11:13 (Jan. 1) 1931.

health department, through an appropriation in the municipal budget, is to quite an extent due to this form of organization. It should be borne in mind that, in case of necessity, each component organization can be mobilized to take an active part in a campaign for such a definite objective. Especially in medium sized towns, such concerted effort would be very effective.

How can the dental profession retain control of such an organization, if the voting power lies in a board of delegates, the majority of whom will be laymen? To answer this, we should recall that the very purpose of the creation of such a council is not to have complete control in the hands of the dentists, but to spread it over the whole community, where it properly belongs. The dental profession should be adequately represented and, in view of its greater knowledge of and closer interest in the movement, there should be no objection to giving the dental group several delegates, possibly three, to one each of all the other component organizations, regardless of size.

As far as the purely technical and scientific procedures are concerned, the professional viewpoint can be adequately protected by the formation in the council of a professional policy committee, consisting of five members, three of which *must* be the dental members of the board of delegates, and a provision in the by-laws that all questions of professional or scientific policy *must* be approved by this committee. This will place effective control of the scientific and professional phases safely in dental hands, while leaving the financial, promotional, educational and social phases in the hands of those most experienced along these lines.

THE COUNCIL'S PROGRAM

Let us assume now that a mouth hygiene council has been instituted according to the plan here suggested, and that a fair degree of cooperation and response from important civic and lay organizations has been obtained. What has been accomplished so far, and what more can the council do to reach its goal?

In the first place, we have now for the first time a civic group actively engaged in trying to carry out the task of promoting mouth hygiene and bringing dentistry within the reach of all people. We have the community speaking to its own citizens and without any possible tinge of self-interest, which necessarily always attaches to efforts along this line from purely dental sources. The voice of such a civic group will therefore receive wider and closer attention, because the public knows that it is listening to an organization that favors no special interests and has only the dental welfare of the community at heart. This alone will be a potent factor in enabling the council to make the community more interested in dentistry, and because its foundations are sound and it is not based upon a spasmodic interest, the results are bound to be more lasting.

To function effectively, the council must develop a program of activities and plan a campaign toward its accomplishment. With the guidance of its dental members, it should not be difficult to obtain a fairly complete program of all worth while activities and objectives. An adequate school dental program should be its first concern, proper care for all adults its ultimate aim. The mouth hygiene movement has been sufficiently developed to readily formulate a more or less standardized program. Valuable help and suggestions can be obtained from the Bureau of Public Relations of the A.D.A.

It should be observed that all com-

petent authorities and laymen agree that the promotion of preventive dentistry is the best approach to any community dental program.[7] Obviously, it is with the child, especially the young child, that preventive work should be started. It is generally felt that an adequate school dental program more than pays for itself in improved health and a reduction of communicable diseases among the child population, as well as in absenteeism, delinquencies and repeating, all of which helps to lower the cost of their education.[8] Moreover, a preventive program, if maintained long enough, will produce an adolescent and adult population with reasonably healthy teeth and gums, and this will materially reduce the cost of dental maintenance and repair in their later years, thus bringing dental care more within their financial means.

The advantage of a compact local organization covering a limited territory becomes apparent when it is realized that local conditions may vary greatly and make the accomplishment of one phase of the program very desirable and feasible in one place, while the same item in another community might be entirely impossible or unnecessary. This means that the program must be varied to meet the local conditions, requirements and resources and will have to be altered from time to time as experience and expediency may demand.

EDUCATIONAL PUBLICITY

There is one phase which should be the foundation stone of activities in each community and that is public education. No mouth hygiene council can fulfil its task unless it does as much educational work as its resources permit. An educational campaign, to be effective, should reach the largest number of people, especially the large group that are not in the habit of obtaining regular dental care. It has frequently been stated that the best educational work is done by the dentist at the chair, but no one has explained yet how by this method the large numbers of people that do not come to us at all are to be reached. The problem of bringing dentistry to the masses cannot be solved unless we preach the gospel of mouth hygiene to those who do not visit us, although often needing our care most, while frequently desiring it least. Of course, when people have been educated to come to us, we should follow up the educational work that has been instrumental in bringing them.

If educational work is to bear fruit on any large scale, it must be directed through channels designed to reach the largest number of people with the least effort and expense. There are many methods of reaching the public, such as by lectures by competent speakers before factory, school and civic groups, radio talks or the use of posters, slides, moving pictures, pamphlets and other printed matter, or by educational articles published in the news columns of the local press. Each of these methods has its place, and all of them should be employed when and where most clearly indicated.

The one method which, beyond a doubt, will reach the most people in the shortest time and at the least expense per capita is the use of educational publicity in the newspapers. It is clear to all unbiased observers that newspaper advertising in general must have warranted

7. Davis, M. M.: Community Dental Service, J.A.D.A., 11:706 (Aug.) 1924; D. Cosmos, 64:498 (May) 1922. William, Maurice: Community Dental Program Versus Dentists' Economic Problems, D. Digest, 5:285 (May) 1929.

8. Gebhart, J. C.: Two Years' Experience with a Dental Program, D. Cosmos, 64:547 (May) 1922.

its cost by commensurate results or it could not have become such a powerful factor in our daily life, nor would such large investments continue to be made in this medium by those who are trained carefully to weigh the advantages of various publicity methods. If dental education is to be a success, we must use that medium that has brought the most effective results in other respects, the public press.

It should not be necessary at this time to go into a detailed discussion regarding the advantages and disadvantages of educational publicity. The need for some method of reaching large numbers of people has been recognized by several well known authors. Edward J. Ryan, now editor of the *Dental Digest*, wrote[9]: "It is enough to say in passing that, within the next few years, we must break free from some of our traditions and antiquated ethics and, as an organization, tell the true story of dentistry to the public."

Henry L. Banzhaf, Past President of the A.D.A., wrote[10]: "Before the dental profession can be of the fullest service to the public, unquestionably the public must be educated fully to the value of dentistry."

Miss Clare Terwilliger, a trained health investigator, in an abridgement of the survey "Dental Clinic Services in the City of New York" by the New York Tuberculosis and Health Association, wrote[11]: "A community dental program presupposes that those who can afford the services of a private dentist are having regular dental care. This is not true, since health education has not yet become so extensive as to make the man of modest means demand dental hygiene . . . "

Michael M. Davis, Ph.D., the well-known medical economist connected with the executive staff of the Committee on the Costs of Medical Care, in a published letter relative to the advertising policy of the Public Health Institute of Chicago, a low-fee pay clinic treating venereal diseases, wrote[12]: "The experience of the Institute has proved that advertisements bring large numbers of people to secure treatment who would not otherwise have obtained any good care for the prevalent communicable and expensive diseases to which the Institute's work has been confined. The issue is whether the medical society will recognize that the legitimate and necessary restrictions upon individual or commercial advertising must be altered in order to enable the community to cope effectively with a public health menace."

Parenthetically, it is interesting to observe that, for some time prior to this statement, the advertising policy and its texts had been approved by a medical advisory board consisting of several outstanding men, prominent in organized medicine and dentistry.

More recently, Dr. Davis, who is also the director for medical services of the Julius Rosenwald Fund, in the report on "Medical Advertising"[13] wrote:

> The education of the public in health matters and the extension of services which are essential to prevent or control diseases dan-

9. Ryan, E. J: Economic Aspects of Preventive Dentistry, J.A.D.A., 18:897 (May) 1931.

10. Banzhaf, H. L.: Fundamental Economic Factors in Dentistry, J.A.D.A., 18:275 (Feb.) 1931.

11. Terwilliger, Clare: New York Surveys Its Dental Clinics, J.A.D.A., 16:1985 (Oct.) 1928.

12. Davis, M. M.: Public Health Institute, "Voice of the People," Chicago Daily Tribune, June 14, 1932.

13. Ross, Mary: Medical Advertising, Report of Julius Rosenwald Fund, 1932. (Chap. 8, by M. M. Davis.)

gerous to the public health have become highly important. Policies and principles should be developed which will facilitate the use of modern methods of publicity for these purposes, while also protecting professional standards.

It is essential to draw the distinction between advertising for public health and advertising conducted with the aim of financial profit. Medical organizations whose codes of ethics now recognize public health advertising in principle should develop more specific policies, appropriate to this field and discriminate these from the policies applicable to individual physicians and to advertising for commercial purposes.

Even the conservative editor of the *Journal of the American Medical Association,* Morris Fishbein, in his latest book, "Fads and Quackeries in Healing," explains the use of educational advertising as distinct from patient-getting advertising. After quoting the paragraph from the "Principles of Medical Ethics," pertaining to advertising (chap. 22, page 342), he writes[14]: "Here is nothing that will prevent a county medical society from engaging in group advertising to warn the people away from cultists, to educate the public as to the advantage of scientific medicine and the dangers of one-track systems of healing."

It is significant that almost at the same time, in September, 1932, the Council of the Illinois State Medical Society unanimously endorsed a report of a special committee appointed to study the advisability of medical advertising which recommended that paid advertising be recognized by medical societies as an ethical means of educating the public.

These few references definitely show that a considerable body of professional and lay opinion has expressed itself in favor of educational publicity and that some of the most responsible men specifically advocate group advertising.

Nevertheless, many members of our profession have not reconciled themselves to such a policy of publicity and agitation against this plan on various grounds has persisted.

AN ACCEPTABLE COMPROMISE

It is questionable whether it would be wise for the components of the A.D.A. to pursue a policy on which dental opinion is still so much divided, for it would be well to remember that, in any campaign to educate the public, success can be assured only if the profession is united. A divided profession, with one faction criticizing the policies of the other, cannot command the respect and following of the laity, nor give it the leadership necessary to insure its cooperation.

With a view to healing the breach that has apparently sprung up between the proponents and opponents of such publicity methods and in the sincere hope of presenting what appears to be a solution which might serve as an acceptable and advantageous compromise between these two standpoints, I would suggest that all educational publicity be carried on in the future by the local mouth hygiene council, which would endorse the text of the messages and by its signature assume the responsibility.

The advantage of this arrangement is clear. The moment the message was signed by the mouth hygiene council, it would no longer be the dental profession that was advertising. Hence, all the real and fancied objections which were raised against this policy and the dire consequences which were feared so much by its opponents will vanish at once. The use of publicity by a civic organization can in no manner be con-

14. Fishbein, Morris: Fads and Quackeries in Healing, New York: Covici-Friede, Inc., 1932.

strued as a license to individual dentists to follow suit. On the contrary, experience has proved that educational publicity will result in the elimination of the unethical advertising dentists from the local newspaper columns. This is a better result than organized dentistry has been able to obtain elsewhere by most other methods. Last, but not least, the stigma of commercialism, or the seeming desire to butter its own bread, on the part of the profession, is removed as soon as it becomes clear to the public that it is a civic organization which is responsible for the publicity.

At the same time, none of the advantages that the proponents are looking for have been lost. The messages are in the public press and are telling their story to the public just as effectively, regardless of the change in signature. More than that: the civic sponsorship cannot but have a favorable influence on the acceptability to the public of these messages. Hence, little opposition among the proponents need be anticipated.

As no new objections to advertising have been developed by this plan, we may expect that such a solution would be acceptable to both factions. Moreover, since the dental profession itself would not be directly responsible for the publicity, this whole question would be removed from the jurisdiction of the A.D.A. and its Judicial Council and the House of Delegates. This might have a salutary effect on the internal harmony of our organization and promote a degree of peace and a cooperative spirit which is very desirable and would stand us in good stead now, when a strong united profession is so badly needed. Let us hope that this suggestion may help to bridge the chasm that threatens to divide our profession, and thus contribute in a small measure to its progress.

TEXT

If we may assume then that the mouth hygiene council will sponsor paid educational publicity, if financial means for such a campaign can be found, let us give some thought to the nature and content of this publicity.

In the past, it has consisted solely of educational material and pictures covering various phases and aspects of dentistry. It was hoped that continued presentation of such material would educate the public to the value of and need for dental care. This can be accomplished only if the campaign is continued for a long time. Education is a slow process, and educating the public particularly takes a long time. It is questionable whether any campaign could be maintained long enough, if kept purely educational, to bring about an adequate increase in the public's knowledge of dentistry and mouth hygiene before exhausting the council's resources. It is a maxim that good advertising can do only what it is meant to do. If advertising is meant to educate, it will have fulfilled its mission when it educates people to the value of mouth hygiene, but this will not necessarily bring them to seek dental treatment.

If it is desired to have the public act on the educational information in a tangible and concrete manner, and avail itself more directly of the benefits of mouth hygiene and preventive dentistry, another policy in regard to publicity must be pursued than has been followed heretofore. This fact has also been emphasized in the report on "Medical Advertising"[13] mentioned earlier. Some important observations on this point are made there. Upon the basis of the experiences of various medical and dental organizations, including the Little Rock group, which carried on purely educa-

tional publicity, and also after the experiences of the Public Health Institute of Chicago, which experimented with various types of publicity, the conclusion is reached therein that advertising, to be effective, must present, besides the educational story, a concrete offer to induce the public to obtain a definite and needed service.

Hence, I would suggest that each message contain the following items:

A. An educational message on some specific dental phase.

It is to be hoped that the material which had been approved by the Educational Publicity Committee of the A.D.A. and was intended for use by the components societies can be made available for use by the various mouth hygiene councils. Of course, if this should prove impossible, new texts could be developed independently. The material prepared previously for the Little Rock campaign could be used in other cities, and vice versa.

It should be emphasized again that, throughout this campaign, prevention should be the keynote of all the messages. The biologic, pathologic and economic advantages of healthy teeth and their preventive care in terms of good health, increased earning power, lessened absenteeism from school and work and the financial savings to be made when the need for the necessarily more expensive restorative dental service is diminished, should be stressed again and again and be at all times interwoven with the specific phase each educational message is to feature. It is only through constant repetition of these simple truths that the public can be made cognizant of the benefits of mouth hygiene, and dentistry, by its general acceptance, be brought within the financial reach of the entire community.

B. A definite suggestion for the reader to visit his own or at least some dentist, in order to remedy the condition referred to in that particular message.

C. A standing offer to examine the teeth of those who have no regular dentist, but whose interest has been aroused sufficiently that they desire concrete information regarding the condition of their mouths and who are willing to obtain this information at the time and place designated in the message.

The idea of thus combining an educational message with a definite service offer and translating newly aroused curiosity into direct action is fundamental in persuading people to follow a desired course and employs the principles that are used in many other practical applications of mass psychology.

A DENTAL EXAMINATION ROOM

To put this suggestion into actual practice, we must offer the public an opportunity to learn, without cost to them, what the exact condition of their teeth is. This can best be done by the establishment of a dental examination room where all patients who respond to the publicity messages may be examined and their conditions diagnosed by competent dentists, told in simple language the true state of their mouths and given a chart stating the findings as tangible evidence of their examination. Such a service alone would be an enormous step forward in approaching the public and would help us to get in touch with many people who otherwise could not have been reached.

It should not be very difficult to provide such a room. The mouth hygiene council should obtain proper space, suitably located near the center of the population that it desires to reach. Under present business conditions, with many stores and offices vacant, such a location

might be found at little cost. With the cooperation of the dental dealers and supply houses in the district, the profession should be able to furnish the room with adequate equipment with only a small outlay of money. Finally, the dentists themselves should be able to work out a schedule whereby they would do the examining voluntarily, each man being on duty in turn during certain hours or days each week, depending on local conditions and the response the persistent offer of free dental examination in successive publicity messages would bring. It would probably be necessary to operate the examination room only a few hours a day, say mornings or evenings, so the burden on each individual dentist would be small, as he might have to serve only once a month if thirty men participated. All this would require some organization talent and goodwill, but, with friendly cooperation, the problem presents no unusual difficulties.

If sufficient funds were available, it might be possible in larger communities to employ a dentist not in private practice to do the examining. It does not seem probable that the resources of the council would permit this for quite a time. In the meantime, the voluntary plan could be used satisfactorily.

It is debatable whether this room should be used for anything other than dental examinations. While it would be preferable to have its use thus restricted, the possible necessity for rendering relief service in emergency cases is recognized. Under present business conditions, this might be badly needed and it would not prove advisable to refuse to accept these cases. Again, local conditions will have to govern the situation, for if adequate facilities for such emergency services are already available in other institutions in the community (hospitals or clinics), it would be far better to preserve the room for its intended purpose: dental examinations.

DISTRIBUTION OF PATIENTS AND RESTORATION OF THEIR MOUTHS

Let us suppose that, after an initial period, patients actually are coming in regularly to obtain examinations. What will they do with the information concerning their dental condition after they receive it? Naturally, many will inquire where the necessary dental care can be obtained and at what cost. It is here that the full possibilities of this plan will be realized. Those patients who previously had obtained regular dental care and still can do so should be referred by the examiner to a dentist, to be selected by the patients from the dental members of the mouth hygiene council who participate actively in this work, or, if it is found more feasible, to the examiner himself. This applies also to patients who are in a position to receive private dental care, although lacking this service before.

Those patients who are unable to pay anything at all should be taken care of voluntarily by the dental members in rotation. Services should be restricted as much as possible to emergencies, relief of pain and prophylaxis and only to those restorations most urgently needed, particularly if they would aid in restoring the health and the earning power of the patient. If, in the course of time, the council should increase in size and resources, it might become ultimately possible, with the financial help of the local governments or charities, to work out a schedule whereby fees could be paid to the dentists sufficient to cover the cost of labor and materials and their share of the overhead expense of such services.

We now come to the larger group of patients, who neither need nor desire den-

tal charity, but who may find regular fees too great a burden at present. This problem requires more organized teamwork for a satisfactory solution, but is by no means unsurmountable. These patients should be assigned in rotation, or by their own choice, to the dental members cooperating with this plan. These dentists should be prepared to render to these patients all necessary emergency and prophylactic service, restorative work being restricted to certain types, such as amalgam and synthetic porcelain fillings, full and partial vulcanite dentures and a limited amount of essential root canal work. Gold work would be beyond the means of patients of such limited income.

Definite fees for each type of work should be determined and deviations allowed only in cases of unusual difficulties or complications. These fees should be distinctly lower than those prevailing in the average modest fee practice in the community. They should at all times cover the actual cost of materials and laboratory work, if any, and a proportionate share of the overhead expense involved for each type of restoration, plus a modest return for the dentist's own efforts. The professional policy committee of the council should be able to work this out to the mutual satisfaction of the dental and lay members and could easily obtain expert advice. Possibly a fee equal to 50 per cent of the prevailing average low fees would be sufficient to cover the items mentioned, at the same time attracting those not used to having or willing to have dental work done heretofore. A similar plan to take care of charity cases in some cities was in use last year, but a much smaller fractional ratio was used for a fee basis.

The dentists could take care of these patients during certain hours of the day, or on certain days of the week. It might prove feasible to do this type of work in the mornings, leaving the afternoons free for regular private practice. Experience and local conditions soon will indicate what is most practical in this respect.

CLASSIFICATION OF PATIENTS

How is this classification of patients to be determined and who shall make this classification? Here again, the advantage of the mouth hygiene council as a soundly built civic enterprise will be manifest. The successful operation of the council will require the cooperation of a sufficient number of social and charitable agencies, active in the community life, that, among their collective resources, will be found an expert knowledge of the financial conditions of most people applying for this type of service, or at least a ready accessibility to the sources of such information. This is particularly true in medium sized communities.

The verification of statements by patients applying for charity or reduced-fee dental care will require the services of people trained along this line, and I am hopeful that such talent can be found within the ranks of the lay membership of the council, or at least can be obtained with their help. With the social experience of the council's components made available for this purpose, this work should entail neither much time nor much expense. Like many other services of a similar nature, this problem may possibly be solved on a volunteer basis.

By means of such a social service as a check-up, the dental members could be given reasonable assurance that the cases sent to them would be worthy of charity or really entitled to modest fees. At the same time, an understanding could be had that these cases were to be handled

on a cash basis, and thereby unnecessary losses through undesirable credit risks be eliminated.

RESULTS

Let us now analyze the results that can be obtained when this plan functions completely as outlined. We will have a civic organization which, under leadership of the dental profession, and with its active help and cooperation, recognizes as its task the providing of dental care to the entire community. This is being accomplished by an effective school dental program and by an educational campaign which, while using all other suitable propaganda methods, is especially aimed at arousing the public's interest, principally through paid educational publicity, stressing preventive dentistry as the most effective and economical method of bringing dentistry to the masses. The dental members are making a definite contribution to this community service by conducting free examinations of all patients who respond to the educational publicity and taking care of all charity cases at no fee, and many others at much reduced fees.

In return, the dentists are benefited, not only by the educational messages constantly reminding the public to visit them, which cannot but have a favorable effect on every private practice, but also by having a certain amount of new work at low fees that they would not and could not obtain otherwise, and which might be sufficient to pay part, if not most, of their overhead expense. As this work can be done during otherwise unproductive hours, of which every dentist usually has many, this in effect might mean a net gain of no small importance to our future practice. I can readily foresee the possibility of covering the entire overhead expense by a large enough volume of this type of work, and this, in turn, should enable the dentists to lower their regular private fees, which would make their services more attractive to larger numbers of private patients. This does not even take into account the probability that many of the patients at reduced fees, sooner or later, might become sufficiently educated to the value of good dental work to desire better types of restorations.

We also observe that this whole service is being rendered by the dental members in a voluntary, cooperative spirit, with a sincere and natural desire to serve the community as well as themselves. This will obviate any need for governmental interference with private practice and silence the demand for compulsory health insurance, low-fee clinics, corporate or contract practice, their advocates within and without our profession to the contrary notwithstanding. Instead, this work is to be done in the private offices of the dentist, who will remain economically independent, and the personal relation between patient and dentist, so highly valued as a fundamental principle by the Committee on the Costs of Medical Care,[15] will not be destroyed. The fees will be set by a committee permanently controlled by the dentist's fellow practitioners and no outsiders or third party will interfere with or dictate to him.

There will be no handicap to his private practice, which, if anything, through the persistent publicity, will be stimulated and improved by patients who may desire to renew or increase their dental budget or start one, if previously they had been oblivious to their dental needs.

Finally, we observe that, in this plan,

15. Wilbur, R. L.: First Three Years of Committee on Costs of Medical Care and Its Plans for the Future, 1930.

we are not indulging in the folly of trying to force dental care on that much discussed 80 per cent of the people who are not now receiving regular dental care, many of whom may seldom need it, or if they do, may not desire to receive such care.[3] Instead, we are offering to serve those people whose interest in and desire for dental service has been stimulated sufficiently through an educational campaign to lead them to apply voluntarily for dental examination. As a result of such examinations and the preventive teachings, many may find that the services actually needed are entirely within their ability to pay. Thus, we again follow the American principle of encouraging private initiative and enterprise by helping those who wish to help themselves, and we do not run counter to long established national customs, traditions and traits.

The community, in turn, will be benefited by having dental service that formerly was not available made so for large numbers of its citizens. This cannot but have a beneficial effect on the public health and is bound to reflect favorably on the community as a whole. It would be interesting to learn how much effect improved dental conditions among school children would have on the cost of education and also how the fewer interruptions of office, factory and shop production by adult workers would help to reduce production costs. Each of these items alone might more than justify any amount of effort, cooperation and expense that is put into such a dental program. While no undue hope is entertained that under this plan dental conditions quickly will become ideal, because of the necessary slowness with which this plan must develop, a definite and great improvement is anticipated and we can foresee how a huge social problem will gradually approach solution and an important contribution to the public's health be made on a scale never possible before. This will truly be community dental service.

FINANCES

We do not have to concern ourselves too much with the expense, and I have refrained from a detailed discussion of finances because the emphasis should not be placed there. If the plan as presented is feasible, and I believe it is; if the right caliber of dental leadership and civic support can be enlisted, and if proper cooperation is given and obtained by a united profession, free from petty jealousies and rivalries, financial problems will have a way of being solved that otherwise would be impossible. Experience has shown that the operation of a mouth hygiene council proper as an organization is not expensive and will require only modest membership fees. Of course, it is logical that the profession as the most interested party should contribute the major portion.

The cost of the examination room should be small if equipment and services are donated from dental sources. It would be difficult to estimate the cost of the needed social service, but I am hopeful that a number of interested experienced social workers may be found among the component organizations who would be willing to give their services at little or no cost.

It should not be too difficult to finance the educational publicity campaign in a community where the dental profession is willing to cooperate. With continued contributions from the dental members for this special purpose, a successful campaign could be financed by the mouth hygiene council at modest cost. In communities where efforts have not been made previously, the example of those that have had experience along this line could be followed.

Substantial contributions from interested private citizens, and ultimately endowments, will always remain possibilities. Much money can be raised by a well managed campaign to sell mouth hygiene seals, which can be featured at a definite time in the year, preferably the spring.

Finally, thought should be given to the not inconsiderable support that properly and ethically could be obtained from important manufacturing and commercial interests that might find material advantage in supporting a movement that would result in increased sales of their products in a community more interested in dental care. As such contributions would have to be made to the mouth hygiene council itself, which would have sole jurisdiction regarding the manner of dispensing the funds, and whose voting control permanently would remain with the delegates from component civic organizations, none of which would be representatives of commercial interests, no possible objection could be raised against the acceptance of such funds. Similar contributions are being accepted by other health agencies.

CONCLUSION

This whole plan is flexible to a marked degree. If in certain communities one phase might not be advisable, another could be substituted, while elsewhere the reverse might be the case. Many technical details of organization have been omitted in this presentation because of the realization that experience will best teach us the most practical method to bring about the desired result. No ironclad scheme, incapable of wide adjustment, was intended. I have only wished to present a general outline of a comprehensive plan for community dental care, capable of modification in accordance with various local conditions and needs. The details will have to be embroidered onto this pattern by those charged with its fulfilment.

The many advantages to be gained from joining the local mouth hygiene councils into a strong uniform national organization, devoted to the task of furthering mouth hygiene throughout the country, should be considered. Useful cooperation between the local councils within a nation wide organization is anticipated with considerable interest.

There is also reason to believe that this plan as outlined may prove acceptable to responsible persons in the A.D.A., which would furnish us the last link in the chain needed for its efficient functioning.

Its success will depend on the degree of honest cooperation and sincere interest in the dental health of the community that can be mobilized among the various contributing civic groups under the social leadership and initiative of our profession.

To such leadership, this plan is presented.

185 North Wabash Avenue.

THE IMPACTED CUSPID*

By WILTON W. COGSWELL, D.D.S., F.A.C.D., Colorado Springs, Colo.

THIS brief discussion of the impacted cuspid will be limited to the three major positions of impaction in which it is usually found, and to the complications that may accompany such types of impaction. Surgical interference for the removal of these teeth becomes necessary under varying conditions; namely, when conservation of the adjacent teeth is essential, when the adjacent teeth are also to be removed from the arch and when the adjacent teeth have been removed previously, allowing the impacted cuspid to remain in an otherwise edentulous dental ridge. No mention will be made of the varying pathologic conditions which may involve these teeth to a greater or less extent. Extensive degenerative processes involving the surrounding tissues and teeth may occur, requiring separate consideration from that of the usual operative problems. Neither will any attempt be made to consider the many anomalies that may occur wherein this tooth assumes an extremely unusual position in the maxillary bone and in its relation to the remainder of the teeth. Such cases demand individual study.

There are few dentists of experience, and especially those whose duties have been limited to surgery, but could produce a volume of roentgenograms and case records of freak cases of impacted and supernumerary teeth, extensive pathologic involvement and whatnot. Fundamentally, those cases may not require so much thought and study for the solution of their operative problems as do the regular offenders such as the third molars and the cuspid teeth, which so consistently seek a more or less expected impacted position. Extensive degenerative processes affecting investing structures as a rule materially reduce the actual difficulties of the tooth's removal. Teeth straying from normal position and supernumerary teeth which may be discovered roentgenographically in unusual positions may startle the eye when first observed, yet will offer far less trouble in their removal than some of the cases of impaction commonly seen.

Classification of the three major positions of impacted cuspids will be given in the order of their prevalence. First is the palatal, the position toward the lingual aspect of the adjacent teeth. Second is the buccolabiopalatal, the one in which the tooth passes through or partly through the dental ridge and its normal space at a semihorizontal angle. Third is the buccolabial position, the one totally to the outside of the adjacent teeth.

The first position is rather common. The second is more apt to result in a partial eruption of the crown through the buccal soft tissue, from whence it can be removed easily or be brought to

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correct occlusion by orthodontic treatment. The third position is fairly rare.

Irrespective of position, accompanying conditions will present one of two operative problems of paramount importance: 1. When the adjacent teeth are to be retained, all of the investing osseous structure between them and the impacted tooth must be conserved in its entirety. 2. When the adjacent teeth must be lost, or have previously been removed, the problem becomes one of conservation of the buccolabial angle of the dental arch for correct denture support.

Results are dependent on an accurate roentgenographic technic and interpretation. This requires at least four intraoral films exposed at various angles to give clear and concise information as to the relation of the impacted tooth to all the adjacent teeth, the condition of their investing structures and the relation to the antral and nasal floors and to the anterior palatine fossa and nasopalatine canal. One regular occlusal film is exposed at an angle which will assure a true shadow of the circumference of each of the four anterior teeth. To obtain such an angle of exposure, the rays must pass accurately through the long axis of these teeth. The position and relation of the impacted tooth to the adjacent teeth is thus established, also the thickness of the intervening bone. One regular dental film is exposed for each of the following angles: (1) through the absolute median line, (2) through the buccolabial corner of the arch and (3) through the bicuspid and first molar teeth. From these, we obtain information regarding the anterior palatine fossa, the nasal and antral floors and the integrity of the investing structures of the adjacent teeth, and a continuous view of the angle of impaction of the tooth as it progresses distally from cusp to root apex. With such information, together with that gained by oral examination of the palatal process overlying the tooth, its depth, angulation, relative position, surrounding bone density and soft tissue tone may be accurately visualized.

Surgical accessibility to such teeth is often determined by the height of the palate vault and the angle of occlusion of the anterior teeth. A low, broad palate is apt to allow the impacted tooth to assume a horizontal position with more marked spacing between it and the adjacent teeth, resulting in much easier accessibility. A high and narrow palate vault with the accompanying constriction of the dental ridge increases the inaccessibility of the tooth, as it will be found higher in the ridge and much closer to the adjacent roots. Especially do we find the inaccessibility increased when the teeth in the dental arch have not assumed a slight outward angle of occlusion. Owing to lack of proper arch expansion, which is very apt to accompany prolonged retention of the deciduous cuspid or the natural constriction of its edentulous space, the adjacent teeth are prone to assume an extremely perpendicular and, in many cases, a retruded position as to their crowns. This retrusion of the crowns of the anterior teeth often creates a dished appearance of the facial profile. The impacted cuspid, in such instances, will be found extremely difficult of access. Observation and recognition of the influence of these variations, relative to speedy and easy removal of an impacted cuspid, may prevent a disappointing result, if it is understood that only by extreme care and with sufficient time can the tooth be removed without permanent impairment of adjacent teeth.

The blood and nerve supply of the palatal soft tissues, derived as it is by

way of the anterior and posterior palatine foramina, divides the palatal field into three areas of distribution. Thus, we have the anterior one third of the palate supplied by way of the anterior palatine foramen and both of the posterior lateral thirds supplied by way of the posterior palatine foramina, with an intermingling and anastomotic relation existing between the three areas. Theoretically, the divisional point between the anterior third and posterior thirds of the palatal blood supply falls at the proximal space between the second biscuspids and first molars.

To avoid a reversal of the source of the blood supply to a mucoperiosteal flap made for surgical entrance to a palatal impacted cuspid, the incision should start at the gingiva between those two teeth and extend inward and slightly backward two thirds of the distance toward the center of the palate. A short extension of this incision made at an obtuse angle forward from the termination of the first incision will greatly increase the extent of exposure of underlying bone without reversal of the blood supply to the flap. Loosening of the gingiva on the lingual aspect, from the second bicuspid to the center of the central tooth, will permit deflection of the entire flap and expose sufficient bone overlying the impacted cuspid without trauma or interference with the nasopalatine nerve or blood supply. Any incision around or close to the anterior palatine fossa or the deflection of any or all of the anterior portion of the soft tissue of the palate toward the distal aspect for bone exposure will cause reversal of the blood supply and court the danger of nutritional impairment, which may result in sloughing of soft tissue and bone infection.

When an impacted cuspid remains in an otherwise edentulous arch, a mesiodistal incision along the lingual plane of the dental ridge from the second bicuspid area to the median line is substituted for the deflection of the gingiva as described above. The palatal incision remains the same.

For buccolabiopalatal impactions, it is at times necessary to create a buccolabial mucoperiosteal flap in conjunction with the palatal flap. Thus, entrance can be gained to all of the alveolar process of the normal cuspid space through which the cuspid passes. Access should be gained, and the impacted tooth removed, through the palate, in all cases where it is possible, to avoid placing the buccolabial plate and prominence in jeopardy.

For buccolabial impactions, the mucoperiosteal flap is raised according to the mesiodistal position of the tooth.

Surgical access through the cortical layer of the hard palate should be obtained by a perforated outline of the anticipated opening with a small spearpoint surgical bur. Once outlined, the encircled bone may be lifted out and the entrance enlarged with bone chisels. Entrance gained through the heavy cortical bone layer, by the chisel exclusively, for access to deeply embedded cuspids, may be productive of surgical shock, due to the heavy malleting. Removal of bone should be limited to that truly overlying the tooth and should not include the formation of extensive surrounding trenches. With horizontal impactions having but a continuous, thin overlying bone from cusp to root apex; the entire removal of such bone is justifiable, so that the tooth may often be removed intact. It must be remembered that the angle of impaction may result in a decidedly thickened mass of bone overlying the apical two-thirds of the root, and its complete removal would, comparatively speaking, double the amount of bone regeneration required. While

the relation between the impacted cusp and the alveolar crest at the median line may not vary greatly, the tooth, from cusp to root apex, may assume an angle of 50 degrees or more. In such cases, the removal of bone should be limited to that overlying the crown and the cemento-enamel junction, following which the tooth may be divided and removed in sections.

Successful tooth division calls for the creation of a space within the tooth itself and not the mere fracture of tooth substance. Dealing, as we do, with the various contours and curvatures of the harder tooth substance, space, either within or without the tooth, must be provided if we are successfully to remove individual sections. Space created within the surrounding bone will not only increase the regenerative period, but may also involve the case in more serious complications. The removal of an excessive amount of bone will either leave unsupported too great a surface of soft tissue or undermine areas of bone and leave undernourished sections. Either case presents increased possibilities of postoperative infection. Space created within the tooth alleviates the dangers of such involvement and provides means for overcoming bone impingement. To divide the tooth, and at the same time create such a space, the use of the 703 cross-cut fissure straight handpiece bur has been found most satisfactory.

The impacted cuspid requires the division of the crown from its root, and also division of the crown itself. This is accomplished by a bur-cut across the neck of the tooth at the cemento-enamel junction to a depth slightly beyond the nerve canal. The crown is then divided lengthwise, from the cemento-enamel junction to the enamel of the cusp, through the center of its exposed surface and to a depth slightly past the pulp chamber. The complete division of the tooth into three sections is then but a matter of rotating an instrument with a flat blade in the two divisional bur-cuts. We now have provided space into which we may collapse the two severed sections of the crown and their removal has been simplified.

A few millimeters of the remaining root is still exposed, and into this is now drilled a traction hole extending at an obtuse angle toward the root apex. A round point contra-angle elevator is now introduced into this hole and sufficient traction exerted to slide the root downward and forward from its socket. This method of tooth removal eliminates the use of bone or adjacent teeth as a fulcrum for instrumentation, and traumatic injury to surrounding tissues is avoided. Such methods may be applied for the removal of all three types of impacted cuspids, and of course for other anomalies encountered, in order to prevent excessive surgical mutilation.

From our experience the following conclusions have been drawn:

Rigid adherence to a complete and accurate preoperative roentgenographic examination is essential to success.

The loss of undamaged adjacent teeth will reflect on the ability of the operator. The removal of the impacted cuspid from an otherwise edentulous arch is accompanied by fewer operative difficulties, but may be set down as a failure if the integrity of the dental ridge height and the buccolabial angle is impaired for future denture retention.

Postoperative pain should not as a rule occur, other than a simple headache.

With correctly designed and readapted incisions and conservative bone manipulation, there is little danger of postoperative tissue slough or infection.

Only rare cases of actual antral perforations, by unmolested impacted cuspid teeth, occur, but surgical abuse may readily create one.

The adjacent teeth or bone should under no condition be used as a fulcrum for instrumentation.

When it is found advisable to prepare the upper arch for a denture, an impacted cuspid should be removed first and an allowance of at least thirty days be given for palatal bone regeneration before the adjacent teeth are removed. Pathologic involvement of the investing osseous structure of these teeth is often so extensive that little or none of this structure may be utilized as a matrix for the support of the overlying tissues.

Bone cannot be regenerated to a height greater than that at which the periosteum may be maintained in a healthy condition through the regeneration period. The removal of an impacted cuspid, simultaneously with several adjacent teeth, often permits the collapse of the dental ridge owing to loss of periosteal support.

At no time should an adjacent tooth socket be utilized for surgical access to the impacted tooth, as such practice invariably results in loss of normal dental ridge form. The practice of deliberate removal of a tooth or teeth to gain access, through their sockets, to an impacted cuspid should be thoroughly condemned in nearly all instances.

Many impacted cuspids are removed from mouths at an age when their retention should be advised and the case referred for orthodontic correction. When such treatment is contraindicated, surgical interference should be instituted as early as possible.

Last, but not least, the integrity of the unaffected and serviceable deciduous cuspid should be respected.

DISCUSSION

Leslie M. FitzGerald, Dubuque, Iowa: Surgical interference for the removal of the impacted cuspid becomes necessary not only in the cases here outlined, but also for the relief and prevention of mental and nervous disturbances. We all have seen cases of headaches and mental, nervous and eye disturbances improved or completely relieved on the removal of impacted cuspids. All impacted cuspids should be removed or brought to position in the dental arch. As has been mentioned, we all have seen many freakish and unusual positions of the impacted cuspid, and while these cases may appear more spectacular and startling, oftentimes they are not so difficult of operation as the types described. Often, extensive involvement of the surrounding tissue materially aids in the removal of the tooth. As Dr. Cogswell has told you, the palatal, or the type toward the lingual aspect of adjacent teeth, is most prevalent and as a rule offers the most difficulty in removal. A definite technic for correct diagnosis and removal must be developed in order to conserve as much tissue as possible and to reduce trauma to the minimum, for the tissue surrounding the adjacent tooth must be conserved. To accomplish this, we must have good roentgenograms, correctly positioned. An occlusal film exposed according to the Simpson method, that is, an occlusal film exposed with the roentgen rays directed downward through the skull and the long axis of the anterior teeth, so as to produce a true shadow of the circumference of these anterior teeth is very valuable in showing the labiolingual relationship of the impacted tooth to the adjacent teeth. Two or three other views are taken at different angles, the regular dental film being used to determine the location of the anterior palatine canal and the proximity of the antral and nasal floors and as an aid in preserving the adjacent structures. A method used by Raper and others to determine whether the impaction is lingual or labial, where there is no overlapping, is very helpful, and is based upon the following principle: "In observing two objects in a direct line, the more distant object will appear to the right as the observer moves to the right, while the nearer object will appear to the right as the observer moves to the left." This is also true in roentgenograms as the tube is moved in the one direction or the

other. When the impaction is lingual, the tooth involved will appear to the right of the overshadowing tooth and vice versa. Stereoroentgenograms are also very useful in some cases. When the cuspid lies labially to the adjacent teeth, it usually can be located by palpation owing to the thinness of the bone on the labial portion of the maxilla. Often, we find a slight elevation in the outline of the tissues of the palate when the impaction is lingual, but not always, owing to the depth of the impaction. We may see a malposed lateral incisor as the result of pressure from the impacted cuspid and the direction of malposition reveals the direction of that pressure. A thorough roentgenologic and oral examination is very important. From these examinations, we are able to determine fairly accurately the position of the tooth, its proximity to the adjacent teeth, the density of the surrounding bone, the location of the anterior palatine canal and the proximity of the antral and nasal floors. As regards the removal of the impacted cuspid: the anesthetic of choice is a local, employing the Smith needle No. 6 and the technic for anesthetizing the second division of the fifth nerve as described by Arthur E. Smith. As Dr. Cogswell has stated, the incision for the removal of the palatal impacted cuspid must be made with great care so as not to impair the blood and nerve supply, which as you know is through the anterior and posterior palatine canals. The technic for the incision which I find very satisfactory is as follows: Starting at the median line, the interproximal gingivae is incised back to and including the proximal space between the second bicuspid and the first molar. Then the incisor is carried inward and slightly posteriorly (with the scalpel blade at the bevel so as to make a more satisfactory suture line) to about the median line. The mucoperiosteal flap is now raised by means of a periosteal elevator and sutured to the opposite side so that it may be kept retracted during the operation for removal of the impacted tooth. To obtain surgical access through the cortical layer of bone, I prefer the use of sharp bone chisels; for I feel that they cause less trauma to the bone. In most cases it is only necessary to expose the crown to the cemento-enamel junction, divide the tooth and remove the crown. The remaining portion of the tooth is drawn forward from its socket into the space formerly occupied by the crown, and removed. The use of a cross-cut fissure bur for the division of the tooth is perfectly satisfactory as all of the tissue which comes in contact with the bur is removed. After the tooth is removed in its entirety, the socket should be examined and thoroughly cleansed of all bone fragments, the wound irrigated with 5 per cent mercurochrome and the mucoperiosteal flap brought back to position and sutured, the gingival sutures being tied on the buccal or labial aspect as they are less troublesome to the tongue in this region. The palatal incision is now sutured and the patient instructed as to postoperative care and treatments. As regards the removal of the impacted cuspid: When all of the upper teeth are to be removed, I see no reason for removing the cuspid and then allowing at least thirty days to elapse before the removal of the remaining teeth and preparation for the reception of the denture, as I do not feel that enough osseous tissue will regenerate in that time to compensate for operating twice in the same region. It is true that bone will regenerate only to the extent to which the periosteum is maintained, as the latter is a bone limiting membrane. If care is exercised, the periosteal ridge can be maintained even though the one side is completely prepared at the time of the operation for the removal of the impacted tooth. The condemnation of the use of the tooth socket and adjacent teeth as a fulchrum is certainly in order.

ACTINOMYCOSIS OF THE HEAD AND NECK*

By FRED Z. HAVENS, M.D., Rochester, Minn.

ACTINOMYCOSIS is of interest to the dental profession since, in approximately 60 per cent of all cases, the head and neck are involved, and, in from 15 to 20 per cent of these, the condition comes on following extraction of teeth. The disease, which in man is caused by the fungus *Actinomyces hominis,* is characterized by chronicity and by a tendency to the formation of areas of induration which slowly break down and form tracts of granulation tissue and superficial abscesses. Pus obtained from such abscesses contains characteristic light yellow granules 0.5 mm. in diameter and known as sulphur bodies. Actinomycosis of the head and neck is fatal in from 8 to 10 per cent of cases.

A disease of cattle known as "lumpy jaw" has been recognized since 1826. In 1877, Ballinger[1] described the condition more fully and showed the causative organism to be the fungus *Actinomyces bovis.* In 1878, Israel[2] described a similar disease in man. It was then believed that the same fungus caused the disease in man and in animals. In 1885, Murphy[3] gave the first description of a case in America. It is only in recent years that the disease has come to be widely recognized.

The bacteriology of actinomycosis has been widely discussed, doubtless owing to the fact that there are approximately eighty forms of actinomyces. These are widely disseminated, especially on the grasses, and the earlier belief was that contact with soil or with grass was a significant factor in the etiology of the disease.

Naeslund[4] isolated several strains of actinomyces from normal mouths, among which was an anaerobic type which seemed identical with the organism found in cases of the disease. Wright[5] studied material obtained from eleven human beings and two bovine animals, and was able to inoculate laboratory animals successfully. He stated his belief that the anaerobe *Actinomyces bovis* is responsible for the disease both in man and in animals, and also that the organism may exist in the normal mouth, in which case it is not in the form of granules, as it is in pus from actinomycotic abscesses or sinuses

*From the Section on Laryngology, Oral and Plastic Surgery, the Mayo Clinic.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 13, 1932.

1. Ballinger: Quoted by Jacobson, H. P.: Actinomycosis: a Clinical Pathological, and Bacteriological Study, M. J. & Rec., 132:342-346 (Oct. 1) 1930.

2. Israel: Quoted by Jacobson, H. P.: Footnote 1.

3. Murphy, J. B.: Quoted by Jacobson, H. P.: Footnote 1.

4. Naeslund, Carl: Studies of Actinomyces from Oral Cavity, Acta path. et microbiol. Scand., 2:110-140, 1925.

5. Wright, J. H.: Biology of Microörganism of Actinomycosis, J. M. Res., 13:349-404 (May) 1905.

but as fragmented mycelial filaments. Breed and Conn[6] worked out a classification of the actinomycetaceae, placing the anaerobic pathogenic types (of which *Actinomyces bovis* is a type species) in one group and the aerobic nonpathogenic types (which have been named nocardia) in another.

Colebrook,[7] an English worker, states that the aerobic fungi having a vegetable source do not conform bacteriologically to the type causing the disease actinomycosis. He further states: "The anaerobic *Actinomyces bovis* has not been demonstrated unquestionably in natural sources outside the animal body." Lord[8] demonstrated actinomyces in material obtained from carious teeth and from tonsillar crypts of patients free from actinomycosis. He inoculated animals with material from these sources and, in 60 per cent of the attempts, omental nodules were obtained which were histologically identical with those of actinomycosis and which contained club-bearing granules.

There is little difference bacteriologically between *Actinomyces bovis* and *Actinomyces hominis*, which probably accounts for the fact that the earlier investigators failed to recognize that the disease in man was not due to the bovine type of fungus. There is a significant clinical difference in that *Actinomyces bovis* produces lesions of bone, whereas *Actinomyces hominis* rarely, if ever, does.

It seems reasonable to believe that the fungi may be present in normal mouths, and that when opportunity is presented, infection takes place and actinomycosis develops. A tooth socket, after extraction, provides in its depths an ideal situation for the growth of the anaerobic fungus, although any break in the mucosa may serve as the portal of entry. The presence of the fungi in the mouth and hence throughout the alimentary tract might explain the occasional occurrence of abdominal actinomycosis following operation. The fact that the head and neck are involved in 60 per cent of the cases of actinomycosis is strongly suggestive that the source of infection is related to the mouth. Although it seems definitely established that the types of actinomyces found on the grasses do not produce the disease, it is interesting to speculate as to why farmers (ninety-one of 163 in a recent series of cases) are more often affected than persons of other occupations.

The lesions consist of fairly well localized areas of induration which slowly soften, with the formation of tracts of granulation tissue and superficial abscesses. The spread of the disease is by continuity and only rarely by the blood stream or lymphatic structures. In the pus from recently opened abscesses may be found the so-called sulphur bodies or granules, which are clumps of mycelia approximately 0.5 mm. in diameter, visible to the naked eye and having a characteristic appearance under the microscope. Histologic examination of sections of tissue removed from an actinomycotic area reveals nothing distinctive, unless a granule can be found. This is difficult and often impossible. It is also difficult to make successful cultures of material from actinomycotic lesions.

The symptoms of actinomycosis vary

6. Breed, R. S., and Conn, H. J.: Nomenclature of Actinomycetaceae, J. Bacteriol., 4:585-602 (Nov.) 1919; 5:489-490 (Sept.) 1920.

7. Colebrook, Leonard: Mycelial and Other Micro-Organisms Associated with Human Actinomycosis, Brit. J. Exper. Path., 1:197-212 (Aug.) 1920.

8. Lord, F. T.: Etiology of Actinomycosis, J.A.M.A., 55:1261-1263 (Oct. 8) 1910.

with the site of the disease, with the virulence of the infection and with the amount of secondary infection. Occasionally, the progress of the disease is rapid, so that an abscess forms in a few days, just as in the case of a pyogenic phlegmon; but ordinarily the induration is slow to break down, requiring from four to six weeks or even longer. Stiffness of the region is a characteristic sign, particularly if the process is in the temporal or parotid regions, when it manifests itself by ankylosis of the jaws. The abscesses when formed tend to be rather superficial and to leave puckered scars when healed. Pain is not usually severe and may be almost entirely absent. There is a marked tendency to chronicity. Cases have been observed in which repeated flare-ups have occurred over periods of ten or twelve years.

Actinomycosis should be suspected in any case in which there has been a slowly developing inflammatory process about the mouth, face or neck. If suppuration occurs, the pus from a freshly opened abscess should be carefully examined for the characteristic sulphur granules. If these are found and their identity is verified by microscopic examination, the diagnosis is established. If one cannot obtain pus from a previously unopened pocket, it may be difficult to find the sulphur bodies because of the presence of secondary infection. It may be necessary to keep patients who are suspected of having the disease under observation for a considerable time in order to prove or disprove its presence.

Because of its hard, deep-seated induration, actinomycosis may simulate some type of malignant disease. Cases in which multiple sinuses have been discharging for a long time may resemble a tuberculosis. In the unusual, rapidly developing type, suppuration occurs within a few days, and it may be impossible to make a diagnosis clinically from the ordinary pyogenic phlegmon.

As regards the prognosis of actinomycosis of the head and neck, it is commonly stated that there is a mortality rate of from 8 to 10 per cent. Difficulty in securing the cooperation of the patients in order to carry out adequate treatment may be a factor in the results obtained. In a recent series of cases, there were 143 in which treatment was carried out satisfactorily, and, in this group, there was only one death. When death occurs, it is usually due to extension of the disease to the cranium or to the thorax.

Treatment consists of four principal measures: (1) radiation by radium or the roentgen rays, which seems to favor the process of localization and suppuration; (2) drainage when indicated, laying open all pockets and keeping them open with iodoform gauze or rubber tube drains; (3) the use of potassium iodid in increasing doses up to the limit of tolerance, which, while given more or less empirically, seems definitely beneficial, and (4) the application of heat locally over the affected area, which makes the patient more comfortable and accelerates the process by producing hyperemia. The average time necessary to effect cure is six months.

SUMMARY

Actinomycosis should be borne in mind in all cases of an inflammatory process about head and neck. The diagnosis, which may be made provisionally on clinical examination, can be verified by the finding of the characteristic sulphur granules in pus from an abscess or sinus. Early recognition of the disease and adequate treatment will result in a lowering of the mortality rate.

SOME OBSERVATIONS RELATING TO THE COMFORT AND CARE OF THE MOUTH AND TEETH DURING MECHANOSURGICAL PROCEDURES*

By RALPH D. COOLEY, D.D.S., Houston, Texas

IN accordance with present day knowledge and practice of aseptic and antiseptic surgery, it behooves us in our special field of dentistry to aquaint ourselves with and avail ourselves of every feature of asepsis and antisepsis applicable to the oral cavity and its contents. Only by so doing can we hope to give ourselves and our clientele the care and protection to which we both are entitled, and in the end arrive at a result that is wholly satisfactory.

For a number of years, I have been distinctly impressed with the very apparent disregard, in our textbooks, current literature and the curriculums of some of our colleges, for the immensely important subject of preliminary preparation of mouths and teeth about to undergo surgical and reparative procedures; also, with the lack of any very definite or satisfactory program or technic for the protection of these wounded areas of dentin, which are so susceptible to bacterial incursion, against the insanitary conditions found in mouths during the period of days, and sometimes weeks, between the time when mechanosurgical procedures have been executed and the final restorations are completed.

It is for the purpose of emphasizing the importance of proper preliminary care and subsequent protection of these areas of the mouth and teeth during this intermediary period that this paper is presented. Also, it will be my endeavor to outline in detail a definite technic which has been developed and proved to fulfil these purposes satisfactorily in my practice.

The patient having been placed in the operating chair in a properly lighted, well ventilated and comfortable operating room, by an assistant who understands the operation of the chair, with the neck-apron or bib placed in position, and having been in every possible way put at ease both physically and mentally, we are ready to proceed with the preliminary antiseptic preparation of the mouth for whatever operative procedures are to follow.

At this time, and while my assistant is preparing the anesthetic solution and the instruments for its administration, I occupy myself with spraying every exposed area of the teeth and the soft tissues of the mouth. For this purpose, one may use any suitable antiseptic or germicidal mouth wash in a spray bottle with not less than 30 pounds pressure of air. A mouth wash containing proper amounts of menthol and phenol is especially desirable—the menthol principally for its cooling and refreshing properties, and the phenol for its slight anesthetic properties. I use for this purpose a solution which is a somewhat

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

complicated mixture both in composition and in preparation. One may substitute for it liquor antisepticus (N.F.5), adding approximately 5 per cent phenol.

Mouths that have had indifferent care by the patient had better be cleansed first by the use of dental tape in all the interproximal areas and a preliminary irrigation be made, but with a proper solution of one of the sodium hypochlorite group of drugs available for antisepsis. These drugs dissolve and remove mucus deposits on the teeth or is purulent, no surgical work should be begun on the teeth until a thorough prophylactic treatment has been given, the patient has been instructed in the home care of the mouth, and a few days have been allowed to elapse for result.

Being now ready to proceed with the injection of the local anesthetic, which is in a proper syringe, and at approximately body temperature, a tiny pledget of cotton is picked up in the pliers, dampened with

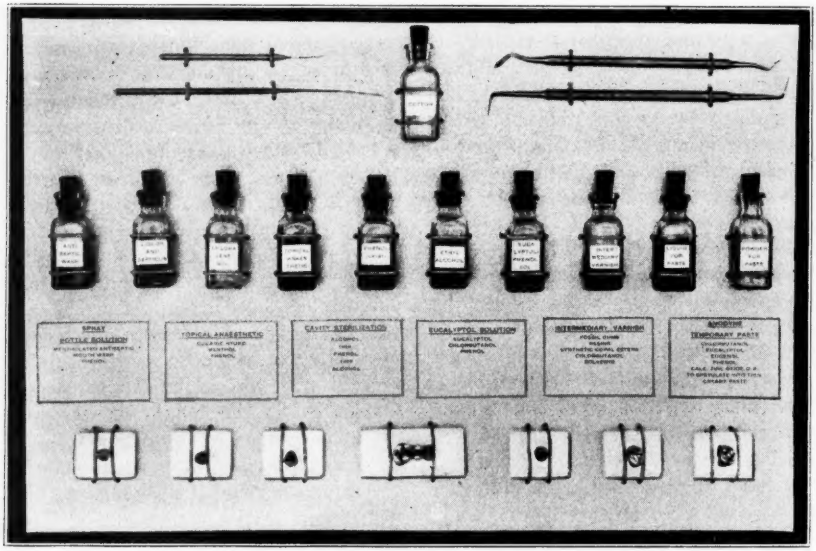

Fig. 1.—Board mounting, showing drugs, formulas, mounting of preparations and temporary replacements, and instruments for their manipulation.

more quickly and comfortably than any that I have found. Chloramine-T, which contains approximately 13 per cent active chlorin, is very desirable for this purpose, used in a 2 per cent aqueous solution, but it should be made up fresh in each instance as it is quite unstable in dilute aqueous solution.

If a mouth is distinctly unclean, shows considerable amounts of calcific deposits on the teeth or is purulent, no surgical work should be begun on the teeth until a thorough prophylactic treatment has been given, the patient has been instructed in the home care of the mouth, and a few days have been allowed to elapse for result.

Being now ready to proceed with the injection of the local anesthetic, which is in a proper syringe, and at approximately body temperature, a tiny pledget of cotton is picked up in the pliers, dampened with a mixture of cocain hydrochlorid, menthol and phenol, and carefully applied against the membrane at the point of insertion of the needle and held there for not less than one nor more than two minutes. The insertion of the needle point may then be made without pain to the patient, provided the operator uses due care not to force it immediately into contact with the periosteum. If it is considered

desirable or necessary that the anesthetic solution be placed adjacent to, or under, the periosteum, sufficient time should be taken and care exercised to inject the solution constantly in advance of the needle to permit the anesthetic to infiltrate this very sensitive membrane before the latter is touched or pierced. When the desired amount of anesthetic has been properly deposited, the needle is withdrawn and the immediate area of its insertion bathed with ethyl alcohol on a suitable pledget of cotton. If more than one insertion of the needle is necessary, each area penetrated should be so treated. When anesthesia of the desired tooth or teeth is obtained, the mechanosurgical operations may proceed.

Fig. 2.—Mesial cavity in incisor prepared and lined with thin layer of intermediary varnish prior to insertion of permanent filling; varnish acting as nonconductor of thermal changes, dentinal tubuli seal, anodyne and adhesive to both dentin and plastic filling.

Although it is not within the province of this paper to discuss the preparation of teeth for the many varieties of reconstructions, I welcome this opportunity to impress on operators that they should proceed with the surgical work on anesthetized teeth with the same degree of care in the important matters of frictional heating, exposure of the pulp, trauma and undue drying of the dentin with air that they would exercise were no anesthetic employed.

The use by the assistant of sterile water slightly cooler than room temperature constantly to bathe the area of the dentin under preparation has proved most desirable in my practice. To this, may be added a few drops of a suitable antiseptic solution if desired; also, it is well to irrigate the tooth and surrounding areas occasionally with the mouth wash in the spray bottle as was done before commencing the operation, thus keeping the mouth as nearly sterile as is possible with the use of antiseptic washes. The use of compressed air on teeth for keeping the field clear during prolonged operations is questionable, as it removes much of the inherent moisture of the dentin, and if of long duration, causes a considerable degree of desiccation, with consequent shock to the pulp. I use air in preparations only on teeth on which it is found desirable or necessary to apply the rubber dam, and then only for the moment or more necessary to complete some delicate undercutting, marginal trimming or the like.

Assuming that the cavity of the tooth under preparation is to be filled at this same sitting the procedure recommended would be as follows: First, the tooth is isolated from the surrounding tissues and the fluids of the mouth by means of absorbent rolls, napkins or the rubber dam. Then tooth and cavity are bathed with alcohol and dried thoroughly with warm air, a solution of phenol being applied within the cavity and allowed to remain for from two to three minutes to cauterize the severed ends of the dentinal fibrils. The obtundent action of this drug is obtained thereby, as well as the germicidal effect on whatever residual infection may have advanced into the tubuli

beyond the actual decalcification and apparent destruction of the caries. This is then neutralized by another bathing with alcohol and the cavity again dried with warm air. We are now ready to insert an intermediary between this dentin and the filling to be inserted.

For this purpose, I have developed the following formula: fossil gums, synthetic copal esters, resins, chlorbutanol and solvents.

This makes a penetrating, quick-drying, hard obtundent and a permanently germicidal cavity lining which seals the tubuli and their contents, occupies practically no space, and is highly resistant to thermal change. It is, of course, not desirable that this solution be applied to any part of the cavity except the exposed dentin. This may be easily accomplished by applying it with the aid of a tiny wisp of a few shreds of cotton wrapped into a ball on the end of a suitable metal probe or applicator, or the tip of a broach or a long-handled root canal file. This is dried thoroughly with warm air, when it will be noticed that the surface of the dentin is merely glazed (Fig. 2), presents a hard surface to the scratch of an instrument and has not the cushioning and nonresistant properties of the so-called "cavity linings" now available to us through various manufacturers.

This varnish has been found especially useful in the cavities which I have filled with the plastic synthetic porcelains because of the resultant complete comfort of the teeth and of the very evident improvement in results obtained in this type of filling itself. The conclusion has come to me that these results are attributable to the fact that different teeth present different porosities of dentin and, therefore, the desiccation of one would not be identical with the desiccation of another; and, since the aqueous content of these synthetic porcelains is so definite and so carefully arrived at, the effect on the material of the absorptive properties of these variables could not but alter the resultant filling. I have convinced myself that this intermediary varnish removes and obviates this important question, because it is the varnish itself which

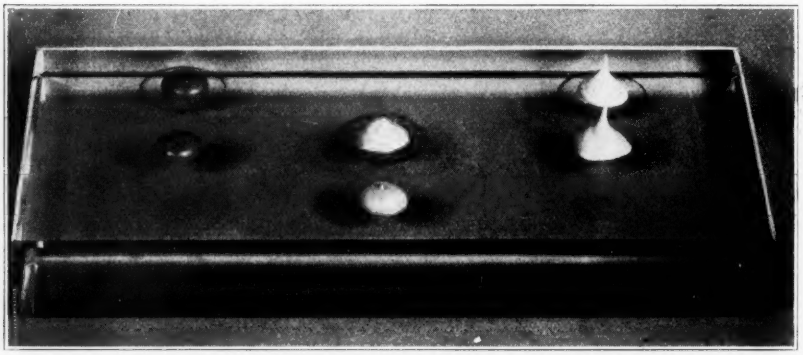

Fig. 3.—Tests made on glass slab, with pairs of identical mixes of, left, oxyphosphate of zinc cement; center, silicate cement, and, right, synthetic filling porcelain. The varnished areas and mixes thereon are surrounded by circles, while those in the foreground are on only the clean glass slab.

is absorbed into the porosities of the desiccated dentin, and, in hardening, it presents a surface to the synthetic porcelain which is neither absorptive nor the reverse.

Figures 3-7 illustrate some experiments which I have made demonstrating quite conclusively that our zinc cements, silicate cements and silicate filling materials have adhesive properties and are adherent to dentin only during their plastic state, and that they have no surface adhesion whatever after the crystallization of setting is complete; also, that each of these does adhere, even under great stress, to an intermediary varnish such as I have developed, which in turn is relatively even more adherent to the dentin of the tooth than it is to the plastic filling. These conclusions quite definitely indicate that our restorations have, in the past, been tremendously faulty in the important matter of hermetic sealing at the juncture of the filling and tooth, without regard to whatever synthetic porcelain or cement or other plastic filling has been utilized. My own conclusion is that we have failed to accomplish our purpose in this regard and with these materials more often than we have been successful.

This intermediary varnish is used routinely on the wounded dentin under any and all types of fillings and restorations by me and by those who have followed me in my experimentation.

The treatment and care of teeth, the restoration of which cannot be completed at the same sitting at which preparations are made is somewhat more involved, but, at the same time, is relatively more important.

In the case of inlays involving but one surface of the tooth, little is necessary other than the care previously outlined and the insertion of a guttapercha filling, which is sufficient to protect the dentin for a reasonable length of time.

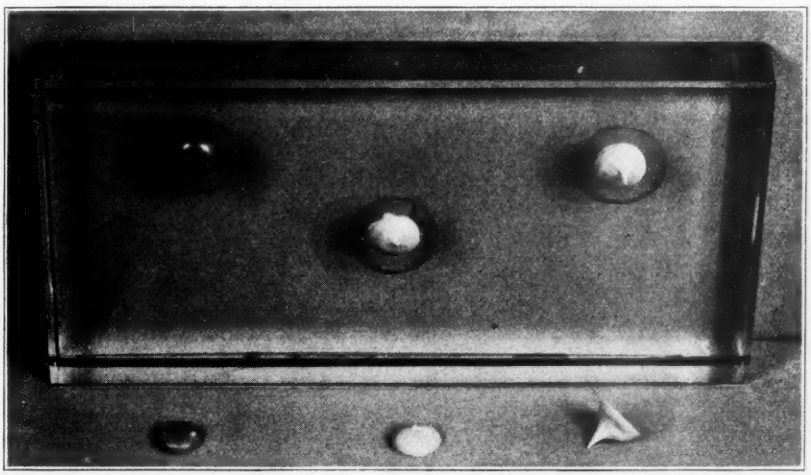

Fig. 4.—Slab shown in Figure 9; turned on its side the following day. All mixes not on the varnish fell off of their own weight, showing total lack of surface adhesion. (It has been impossible to push off the ones on the varnish with finger pressure.)

In preparations involving two or more surfaces, and in which the adjoining and contacting teeth are in position, it is my practice to proceed with the alcohol application, drying, the application of phenol followed by alcohol and again drying as outlined before. Then the cavity is flooded with a solution consisting of eucalyptol, chlorbutanol and phenol. Any excess is absorbed with dry cotton, the guttapercha inserted and the patient allowed to impress the occluding teeth into it, the excess trimmed away, the mass chilled and the patient dismissed.

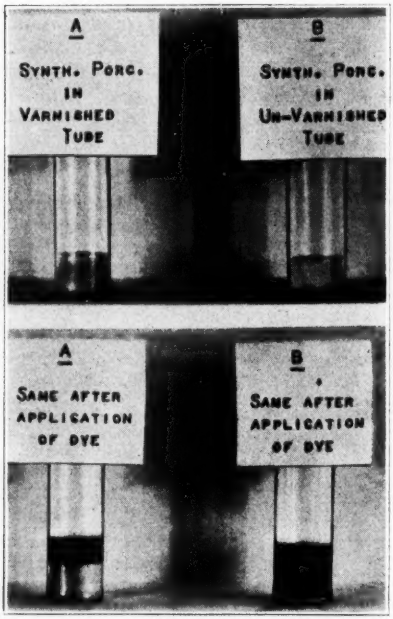

Fig. 5.—Tests made with identical mixes of synthetic porcelain in glass tubes; demonstrating control of shrinkage of porcelain in varnished tube and perfect sealing. The unvarnished tube permitted leaking of the die between tube and filling; which demonstrates shrinkage in the porcelain filling itself and no adherence or sealing between it and the tube.

Where two or more contacting teeth have been prepared, this same procedure may be carried out; or if the cavities are all rather deep-seated and it seems advisable to obtain a greater amount of obtunding of the sensitiveness of the dentin, the following procedure may be substituted (Figs. 8-9): Being sure that the cavities are moist so that the guttapercha will not adhere, we thoroughly warm a sufficient quantity of the temporary filling to assure an excess, insert it into the cavity and then permit the patient to bite. We trim away the excess of the mass, smooth, chill and remove it from the mouth, dry it and make up a thin paste of chlorbutanol, eucalyptol, eugenol and phenol, with a sufficient quantity of calcined zinc oxid to spatulate into a thin creamy mixture.

We apply this to the cavity surface of the temporary filling very much as cement would be applied to an inlay, then isolate the teeth involved, treat the cavities with the alcohol-phenol-alcohol procedure outlined before, dry them and replace the temporary filling in its cavities, instructing the patient to again bite, when the filling will assume its original position. The excess paste may be then washed away, leaving only that which remains between the guttapercha and the prepared surfaces of the teeth as a seal and a very effective obtundent and antiseptic.

In the case of three-quarter crown preparations (Figs. 10-12), we select a suitable aluminum band, trim it to the gingival festoon, cut away all of the band on the buccal surface except a narrow strip at the gingival third, trim to an outline on the occlusal surface that will bring it clear of the opposing teeth, fill with warm guttapercha and force to place on the moist tooth, allowing the patient to bite, trimming away the excess guttapercha

and chilling in position on the tooth. It may then be removed, dried and filled with a thin solution of eucapercha compound, or, if the tooth has one or more deep-seated cavities, it may be filled with the paste of eugenol-phenol-eucalyptol-zinc oxid outlined above. The tooth is then isolated, treated as above with alcohol-phenol-alcohol and the band and its contents forced into the original position, any excess washed away and the patient dismissed.

The care of full crown preparations is quite simple and very effective. (Fig. 13.) We select an aluminum shell which

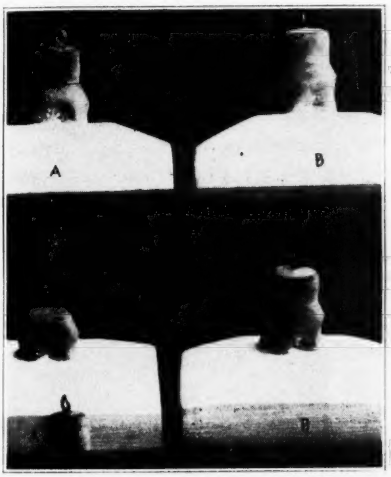

Fig. 6.—Tests made on two molar specimens with occlusal surfaces cut to the dentin, flat, and as nearly as possible identical in shape and area. The one specimen (*A*) was left clean and dry on this prepared surface, while the other specimen (*B*) was coated on the prepared surface with a thin layer of the intermediary varnish. They were then boxed in and filled with oxyphosphate of zinc cement, and steel loops inserted and allowed to set. (The steel loops were for attachment in subsequently testing surface adhesion and the relative or comparative pull necessary to dislodge each.) When these boxings were removed the following day, it may be seen that specimen *A* (on clean dentin and without varnish) separated, and, below, fell off of its own weight. Specimen *B* (containing intermediary varnish between dentin and cement) was turned over to the Southwestern Laboratories for tests.

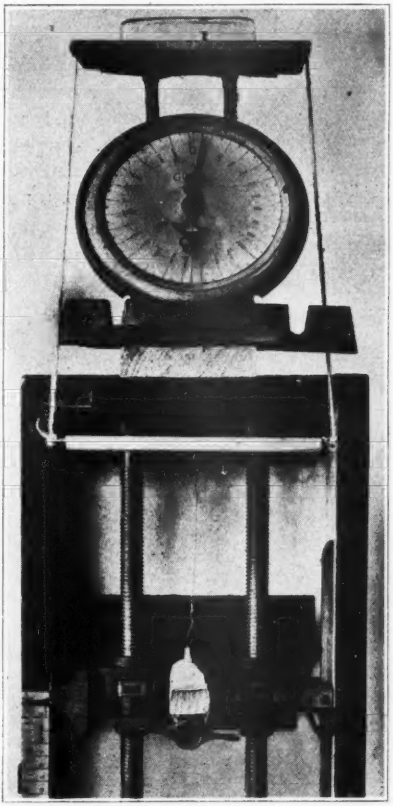

Fig. 7.—Testing machine of Southwestern Laboratories with specimen block near bottom of picture with wire attached and machine checked at point at which union between cement and varnished surface of dentin was broken. The technical report was as follows: maximum stress, 1,500 gm.; area exposed, 27 square millimeters; stress calculated as pounds per square inch, 77.6.

will fit snugly at the gingival margin, then select a suitable cusp in a cusp die plate and swage the shell into this with the aid of a pointed soft white pine stick. This may be supplemented with unvulcanized rubber, which will swell the shell to a satisfactory degree of convexity for contact with the adjoining teeth. We cut away and festoon the gingival border until the top of the shell comes nearly to a seat on the occlusal aspect, instructing the patient to indent this thin shell with the opposing teeth and after assuring ourselves that it does not impinge on the gingivae and that the contact points with the opposing teeth are satisfactory, we remove and dry. We make up a mixture of the anodyne paste, crimp the gingival edges of the shell with contouring pliers and fill sufficiently with the paste. We then isolate the tooth to be crowned and treat it with the alcohol-phenol-alcohol and replace the temporary shell upon the tooth, allowing the patient to bite it into its original position. We then wash away the excess and dismiss the patient.

The two latter temporary procedures, utilizing the bands and shells, may be repeatedly used on the same teeth when necessary by carefully removing them, cleaning out and renewing the contents, and replacing them again on the prepared teeth.

When the patient returns for fitting or insertion of the desired artificial piece, the mouth should be cleansed as before. The temporary fillings, bands or crowns may then be removed and their residual contents wiped and washed from the exposed dentin. If eugenol has been used, a slightly yellowish tint can be seen, denoting its having been actually absorbed by the dentin, which is most desirable. In any and all cases treated by any of the methods suggested, it will be noticed that the dentin, while not totally desensitized, is obtunded in sensation and the teeth are quite healthy and comfortable.

Before the final setting in the restoration of any tooth, I would recommend that the alcohol-phenol-alcohol procedure be again carried out, and the exposed

Fig. 8.—Mounting demonstrating series of adjacent cavities filled while moist with guttapercha, the guttapercha then properly trimmed, chilled, removed and hollowed out with bur in areas over deeper areas of dentin. It is then thoroughly dried and filled with anodyne paste, the teeth are isolated, cleaned and dried and the guttapercha is replaced.

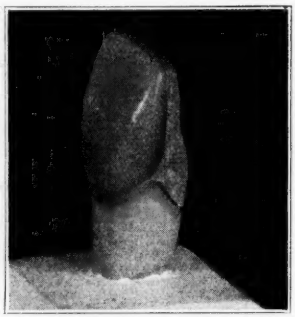

Fig. 9.—Mounting showing facing hollowed out and undercut on lingual surface leaving only a thin labial veneer, filled with guttapercha for temporary replacement over tooth prepared for a porcelain jacket crown.

dentin painted with a coating of the varnish for the reasons given before. The artificial piece is then cemented to place.

Fig. 10.—Mounting showing 36-gage aluminum band cut diagonally, then open-faced and filled with guttapercha for temporary replacement on cuspid prepared for three-quarter crown. This is equally applicable to all the six anterior teeth, upper or lower.

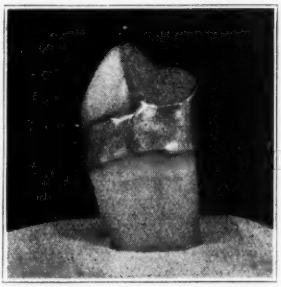

Fig. 11.—Mounting showing 36-gage aluminum band cut to retain guttapercha filling on bicuspid prepared for three-quarter crown.

Thus, the cementing medium is never permitted to come in actual contact with dentin to penetrate it and irritate its sensitive contents. In the event the technic and procedures outlined above seem complicated, let me emphasize that they are by no means so. On the contrary, they can be carried through as routine procedures, with little expense in time on the part of the operator, and will repay him in results, and his patient in comfort, many times over, for the effort expended.

Fig. 12.—Mounting showing 36-gage aluminum shell filled with guttapercha and cut out only at the prepared bucco-occlusal margins for temporary replacement on molar prepared for three-quarter crown.

Fig. 13.—Full crowns of 36-gage aluminum made from aluminum shell and swaged into suitable mold of cusp die plate with aid of soft white pine stick and unvulcanized rubber. When contact points and occlusion have been approximated and gingival margins suitably trimmed, the crown is filled with anodyne paste and inserted on the prepared teeth in a temporary replacement. Modifications of this temporary crown may be constructed and used for all posterior teeth similarly prepared, thus maintaining the tooth in contact, occlusion, comfort, cleanliness and original position.

CONCLUSIONS

1. No mechanical procedures should be begun on the teeth which will involve any exposure or wounding of the dentin, without first rendering the mouth and its contents as nearly sterile as may be, with suitable antiseptics and germicides.

2. The dentin should be securely sealed against any exposure to air, or to any of the fluids of the mouth or anything else during the time between sittings.

3. Deep seated cavities should carry a soothing, obtundent and germicidal drug or drugs under the temporary seal in the interim between sittings.

4. All dentin should be protected from actual contact with the permanent fillings, whether they be cements, silicates, amalgam, gold or other metal or material, by a sealing, soothing obtundent germicidal or antiseptic intermediary.

5. It is my firm opinion that all cases of pulpitis and pulp death following surgical interference are directly traceable to (1) either trauma or heating or prolonged desiccation during surgical preparation of the tooth; (2) mechanical or chemical or thermal irritation due to placing in actual contact with the dentin some filling material having one of these disadvantageous properties, or (3) the presence within the dentinal tubuli of residual infection which was already present and not eliminated or neutralized, or which was incurred or ingested because of improper protective measures on the part of the operator during the progress of the mechanosurgical procedures.

CAMOMILE THERAPY IN DENTISTRY: ITS POSSIBLE APPLICATION IN VINCENT'S INFECTION AND SUPPURATIVE PARADENTOSIS*

By HERMANN BECKS, M.D., D.D.S., San Francisco, Calif.

THERE are a number of recognized agents for the treatment of acute inflammatory processes in the oral cavity which have brought good results in the hands of practicing dentists and physicians. The many failures, especially in the treatment of the "ulcerative type of gingivitis and paradentitis (Vincent's infection)," as well as the suppurative forms of paradentosis, have led, in the last few years, to a reopening of the investigation of methods of combating these disease conditions of the paradentium.

Clinical and experimental experience with preparations of camomile, which has recently held the attention of the profession, was the outstanding feature of the discussion of gingival therapy at the Eighth International Congress, held in Paris in August, 1913.

In the year 1921, pharmacologists succeeded in determining accurate dosages for the use of the very valuable constituents of the plant "matricaria chamomilla," which is known under the name "camomile." This information made it possible to utilize in medicine and stomatology its excellent pharmacologic properties, which had been ac-

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cepted in home treatment for many years. The "German camomile," in the form of an infusion and cataplasm, has been a favorite home remedy because of its anesthetic and sedative effects. According to our present knowledge, the important constituent in the blossom of matricaria chamomilla is an etheric oil, the "blue oil," which was studied scientifically by the well-known pharmacologist Binz. It is viscid, a dark blue, has a specific weight of from 0.92 to 0.94, and is soluble in from eight to ten parts of alcohol. Binz showed, in animal experiment, the anesthetizing and relaxing effect of etheric oils and proved *in vitro* as well as in animal experiment the disinfectant properties. Besides, this "blue oil," certain glycocytes, vegetable bitters, and tannic substances are active constituents of camomile.

Scientific medicine has always disparaged the use of empiric remedies. One of the aims of modern science is, naturally, to isolate and concentrate effective constituents of pharmaceuticals, making possible the determination of definite dosages. Camomile, prepared as a "home remedy," falls far short of scientific standards as regards constancy of composition. The content of effective ingredients is dependent on the locality in which the plant is grown, the time of collection and the condition of the material. Furthermore, a certain amount of matter foreign to the decoction, such as particles of the blossoms or dust, difficult of removal by simple home methods, has usually added to the variability of composition.

Today, camomile need no longer be regarded as chemically unreliable. The systematic studies, made in the Chemico-pharmaceutical Laboratories Bad Homburg, of the adaption of camomile therapy to the demands of modern medicine have finally led to the isolation of the various ingredients of camomile[1] and to the development of a camomile preparation which can be prescribed in exact dosage. This is called "camillosanum liquidum" and is listed with other pharmaceutics.

In the last few years, a large number of scientific publications have been issued concerning this preparation, dealing mainly with clinical experiences in its use in all divisions of medicine and especially in dentistry. Foremost among these are the examinations of Reicher,[2] which proved by experiments that camillosan has a marked antiphlogistic effect. Arnold confirmed these observations in his interesting experiments and called attention to the astringent properties of camillosan, which leads to a contraction of the skin capillaries. It might be added that camomile solutions are absolutely nonirritating, which makes them especially useful irrigants in the treatment of sensitive and allergic tissue (Bier,[3] Scheff,[4] Mish, Krecke[5] and Gaza[6]).

The camomile flower has an extremely strong odor and also acts as a deodor-

1. The fresh camomile flowers are examined by special process, first quantitatively for content of etheric oils, those of very low content being excluded. The plants are then dried, pressed and prepared by complicated extraction and filtration processes.

2. Reicher, K.: Zur Therapie der akuten und chronischen Dysenterie, Kolitis, Sigmoiditis und Proktitis. München. Med. Wchnschr. No. 7, 1925.

3. Bier, A.: Die Behandlung der von den Händen ausgehenden Wundinfection der Aerzte, München. med. Wchnschr., 68:1087 (Aug. 26) 1921.

4. Scheff: Handb. d. Zahnh., 1910.

5. Krecke, A.: Zur Behandlung akuter chirurgischer Infektionen und Eiterungen, München. Med. Wchnschr., 73:393 (March 5) 1926.

6. Gaza: Grundriss der Wundversorgung und Wundbehandlung, 1921.

ant in the treatment of all putrescent processes, a fact which is particularly valuable in the treatment of Vincent's infection.

Concerning the pharmacologic properties of camillosan, it may be said that it is pleasant in taste, mild and nonirritating, slightly astringent and markedly histiotropic; has a sedative, relaxing and anesthetizing effect, and is a deodorant. These excellent properties explain the popularity that it has attained during the past few years in medicine and dentistry.

Different preparations have been developed for therapeutic use in special fields. One of these, which is in the form of tablets, is a combination of camomile with hydrogen peroxide, arnica and sage. This combination unites the deodorant, anesthetic and antiphlogistic properties of camomile with the disinfectant properties of hydrogen peroxide. A second preparation, in the form of a cream, contains 14 per cent camillosanum liquidum as an active principle. A third is a sterile solution of salicylic phenyl ester in lipoid soluble camomile constituents.

CAMOMILE TREATMENT OF VINCENT'S INFECTION

Recently, Hopusch[7] has again called to our attention the extremely important general medical rule that, in wound disinfection, our aim must be so directed as to aid those biologic processes which the organism itself ranges against infection. In other words, our main consideration should be not merely to kill the harmful bacteria by the application of drugs, but also to support the efforts of the tissue to resist inflammatory processes. The vitality of the tissue cells should never be sapped by germicidal agents.

In the treatment of Vincent's infection, as well as suppurative forms of paradentosis, the factor of increasing the resistance of the tissue is frequently overlooked. The various agents recommended sometimes cause severe injury to the mucosa of the oral cavity. The great variety of "cures" which are used in practice, among which the caustics are preponderant, proves that there is no uniform remedy which satisfies all demands. Perhaps such a panacea will never be discovered.

The many publications of the last few years which deal with the therapy of Vincent's infection clearly demonstrate that much is still unknown concerning the pathogenesis of this disease.

If, in the field of medicine, the treatment of a disease fails and no progress in research is made, there must be something basically wrong, i. e., certain factors in the course of the disease—factors which may perhaps be anatomic, bacteriologic or clinical—are not understood. This especially is true in the problem of Vincent's infection. We know that it is characterized by a definite clinical picture; we also know that this clinical picture is the result of an extreme inflammatory process of the gingiva and mouth mucosa. Concerning the bacteriologic phase of it, there are many questions still open for investigation.

In Vincent's earliest publication, in 1904, written in the French language, we find that Vincent's major claim to honor lies in his recognition of the fact that a certain condition of the tonsils constitutes a disease entity characterized by definite clinical and bacteriologic symptoms. He reported that in an ulceromembranous form of angina, he

7. Hopusch, A.: Die Anwendung der Kamillosan Präparate in der Mundbehandlung, Zahnärztl. Rundsch., No. 35, 1929.

found spirochetes and fusiform bacilli living in symbiosis.

The real discoverer of the symbiosis of spirochetes and fusiform bacilli, H. C. Plaut,[8] has not been given recognition in the designation of the disease, although he reported in 1894, i. e., ten years earlier, the association of spirochetes with the "bacillus of Miller" in certain diptheroid anginas. For this reason, this disease of the tonsils is designated in many countries as "Plaut-Vincent's angina" and the term is reserved only for a specific disease of the *tonsils.*

"Angina" is derived from the Greek root *angh,* "to compress, to lace," and the designation "angina" may be used, quite in general, to describe any disease which is accompanied by a feeling of constriction, especially inflammation of the tonsils and the soft palate, accompanied by difficulty in chewing, swallowing and speaking. The term is also used in the case of angina pectoris, a disease of the heart.

Neither Plaut nor Vincent has stated that the two organisms which they found to be associated with the disease constitute necessarily its cause. Their report is only that these two organisms are found together in smears when the picture of an ulceromembranous disease of the tonsils is observed clinically. The same is true of the mouth mucosa. We know that, in many cases, the diseased area does not continue to be confined to the tonsils but spreads, quite frequently to the uvula and neighboring parts. It may even involve the entire oral mucosa, but sometimes involves only the mucosa of the gums, and sometimes that of the cheeks. In the first instance, the angina is accompanied by a gingivitis; and at other times, a stomatitis is present. Experience has taught us that the involvement of the cheeks and the gingiva does not always begin at the tonsils, but that the ulceromembranous disease can occur primarily as a gingivitis or a stomatitis. Clinically and pathologically, these diseases appear to be identical with Plaut-Vincent's angina, with the exception of their location, and the dentist speaks of "Vincent's infection."

The rich bacterial flora of the mouth cavity has made it impossible to fasten responsibility for this disease definitely on one or another organism. In almost every healthy mouth, we find streptococci and staphylococci, which we know may become very virulent. We also frequently find the Vincent organisms in well cared for mouths, but we do not know very much about their virulence. In other words, little is known of the etiology of the disease considered from the bacteriologic standpoint and we have no scientific answer to many questions:

1. We do not know how many different types of spirochetes exist in the mouth. Bacteriologically, *Treponema vincenti, Treponema buccale, Treponema macrodentium, Treponema microdentium* and *Treponema mucosum* are well known. These are found everywhere under normal conditions in every mouth, without manifesting any pathogenicity. In a smear made from the involved area, we find all forms of spirochetes together, and it is extremely difficult, if not impossible, for a person of average training to differentiate them accurately according to types.

2. We do not know under what conditions these otherwise harmless saprophytes, or "opportunists," of the oral cavity become pathogenic.

8. Plaut, H. C.: Studien zur bakteriellen Diagnostik der Diphterie und der Anginen, Deutsch. med. Wchnschr., No. 49, 1894.

3. We do not know how many different types of fusiform bacilli exist in the mouth. Investigation indicates that there are probably more than four.

4. We do not know which of these spirochetes and fusiform bacilli live together in symbiosis or how to explain the symbiosis of these two micro-organisms. We do not even know whether the findings of Tunnicliff are to be accepted or not. She believed that the spirillum forms are derived from or form a stage in the evolution of *Bacillus fusiformis.*

5. We do not know whether Vincent's infection is really produced by these two micro-organisms.

6. Since all of these questions have in no way been answered scientifically we also do not know whether the generally recognized contagiousness of the disease depends on the spirochetes and fusiform bacillus or on the vibriones or cocci, i. e., streptococci or staphylococci, which are always to be found together with them.

Therefore, since we know from Plaut and Vincent only that spirochetes and fusiform bacilli are found in symbiosis in the ulceromembranous disease of the mucosa, and since this fact constitutes no answer to the above-mentioned questions, no bacteriologic findings from a smear can help us at all in establishing the etiology and in diagnosis, treatment or prognosis of the case. I believe that the importance of the smear test in practice is greatly overemphasized in the light of the present status of our knowledge. The determining of the etiology, i. e., as to whether the spirillofusiform symbiosis produces the disease or is only incident to it, cannot be accomplished by smear, but only by definite bacteriologic experiment, which has not as yet been accomplished. For diagnostic purposes, the smear test is, I believe, extremely unreliable. Even though we know that, in ulceromembranous disease of the mucosa, spirochetes and fusiform bacilli are present, we should not forget that these opportunists are to be found, if smears are made, on all inflamed surfaces of any mucosa, i. e., of the intestinal tract, as well as of the respiratory tract and the oral mucosa. Therefore, we can expect them also in mercurial gingivitis or stomatitis and in scorbutic disease of the oral cavity. If, in diagnosis, too much emphasis is placed on the smear, we may fail to recognize the underlying disease, and harm may result to the patient.

Since it has not been proved that these micro-organisms really produce this disease, it is immaterial whether this form of gingivitis or stomatitis results from the presence of streptococci or staphylococci or from spirochetes in association with fusiform bacilli. The infection, as such, is, as far as we know today, always secondary. In a healthy organism, with a hygienically clean mouth and resistant gum tissue, we never find gingivitis of any kind.

The findings of the smear test are also unimportant in therapy, because, regardless of the bacteriologic findings, from a clinical as well as pathologic standpoint, all areas of gingivitis must be treated fundamentally in the same manner, except when the condition is specific, i. e., syphilitic, gonorrheal, diphtheric, etc. The treatment must consist mainly in supporting the tissue in its effort to combat the inflammation, either locally or systemically. The result of the smear test, therefore, will never determine the type of treatment.

And, finally, this test is absolutely worthless for the prognosis. From clinical experience, we know definitely today that, in most cases, a gingivitis of long standing, for instance, requires treatment

over a more extended period of time than does an acute Vincent's infection, which may be arrested or even completely cured within ten days or two weeks.

Then why should we make a smear test in practice? It is a routine procedure frequently resulting in the diagnosis of Vincent's infection when the condition is actually only a simple suppurative type of gingivitis without any formation of ulcers. The microscopic examination of a smear in the office is only a scientific gesture, based on extremely inadequate knowledge.

If the average practitioner depends so much on the smear test, why is it not made in every case of inflammation of the oral cavity? Why does he overlook the streptococci and staphylococci which are present? We know that they may become extremely virulent under certain conditions. And why does he not name the disease for them? The answer is generally given that, where spirochetes and fusiform bacilli are present, the possibility of contagion exists and that the course of the disease is much more rapid than in a streptococcic or staphylococcic gingivitis. This has no basis of proof, because the possibility exists that the streptococci and staphylococci are the real originators of the disease and produce tissue necrosis; while the spirochetes and fusiform bacilli use this necrotic tissue as a favorable medium for their multiplication.

Summarizing, I want to warn the profession strongly against the continuation of this routine method of the smear test and advise them rather to take into consideration the *clinical or morphologic* picture, which will give a better idea of the development of the disease than the bacteriologic findings of a smear would. On the basis of present knowledge, the smear test does not afford any information concerning the etiology, the diagnosis, the therapy or the prognosis of the disease.

And now as to the treatment of the disease: Almost every issue of the monthly dental journals brings articles on Vincent's infection and new methods of treatment. Obviously, the profession as a whole is not satisfied with the accomplishments in this particular field of dentistry, and we all know that for years no progress has been made.

As long as we cling to the idea of primary infection by spirochetes and fusiform bacilli, a theory which has as yet no scientific foundation, we are inclined to base therapeutic procedures on the principle of combating the micro-organisms. We forget, meanwhile, that we should be treating, not the bacteria, but the host, i. e., the gum tissues. Furthermore, if we keep in mind that, to our ignorance in the bacteriologic field, is added complete uncertainty as to the influence on the micro-organisms of the therapeutic agents frequently recommended in Vincent's infection, it becomes evident that, to a large extent, we are working blindly.

As mentioned before, our aim in the treatment of the disease must be to help the organism in combating the inflammation. This can be done in different ways. In some cases, the systemic condition of the patient indicates a general disturbance and, in others, we find local disturbances which may furnish the primary cause for the disease. The causes can be determined in most cases by an exact anamnesis and examination, and treatment recommended. When there is a suspicion of systemic disease, the case must be turned over immediately to a physician in order that the underlying causes may be treated simultaneously with the local disturbance. If this factor

is overlooked, failure in the treatment of the local manifestations in the mouth will result. The local treatment must have as its goal the raising of tissue resistance by the establishment of absolutely hygienic conditions in the mouth and restoration of normal circulation. The local, or external, irritating cause, i. e., the presence of calculus, débris, food plaques, etc., must be eliminated. This should be done as soon as possible, as in the case of any other gingivitis.

Opinions vary widely as to the application of drugs and other remedies. Almost nothing is known of their effect on the spirochetes and fusiform bacilli. All we know is that, in certain cases, the spirochetes and fusiform bacilli are diminished in number after treatment; but we have no knowledge of the processes by which this has occurred. We do not know whether the remedies have killed the micro-organisms or have merely washed them out; whether they have an antiphlogistic effect or must be considered as valueless, or, whether, in short, we might have secured the same results without their use. In fact, many authors have reported good results without the use of any medicaments. How can we explain this? The solution of the problem may not be so difficult as it appears at first sight. No specific therapy exists as yet for this ulcerative gingivitis, because we do not know any specific etiology. The agents which we supply may perhaps act in a certain bactericidal manner, i. e., they may kill gram-positive cocci. This is known in the case of crystal violet and brilliant green (viogen). We do not know whether they penetrate deeply enough to reach and kill the spirochetes and fusiform bacilli which have entered the tissue, assuming for the moment that these are responsible etiologically. We do not even know whether they attack the Vincent organisms at all. Some agents, by their alkalinity, may perhaps effect a change in the tissue reaction, which is acid in highly inflamed processes (Schade), and thereby produce an antiphlogistic effect. Others may act only as an irrigant.

This explains why the different agents produce varying results. If we eradicate only the local causes, with general treatment and careful avoidance of instrumetal injuries, we may produce results similar to those of investigators who treat the tissues with all possible kinds of drugs, the pharmacologic properties of which are not definitely known. An example of such a drug, which has been frequently recommended, is viogen, also called Berwick's solution. As to its action, we know very little. As the literature reveals, it was recommended in 1918 by C. H. Browning[9] as an antiseptic for mucous membranes and was used by Berwick[10] as an antiseptic for operations in the mouth, not necessarily in connection with Vincent's infection. Nothing is known of its effect on spirochetes and fusiform bacilli. Our experience shows that the number of bacteria has been diminished after a treatment with viogen, but we should not forget that we may secure the same results with other medicaments. Its use is based purely on empiric experience.

From Merritt's book[11] on periodontal disease, I learn that arsphenamin together with glycerine, directly applied to the affected parts, is recommended. This

9. Browning, C. H., and Bonney, V.: Sterilization of Skin and Other Surfaces by Mixture of Crystal Violet and Brilliant Green, Brit. M. J., 1:562 (May 18) 1918.

10. Berwick, C. C.: Disinfection of Oral Mucosa with Crystal Violet and Brilliant Green, J. D. Res., 2:21 (March) 1920.

11. Merritt, A. H.: Periodontal Diseases, New York: The Macmillan Co., 1930.

treatment also is based purely on empiric evidence. From laboratory experience, we know that arsphenamin itself is not at all injurious to the spirochetes, but gains toxicity only as phenylarsenic oxide, through special cell activity of the reticuloendothelial organs. If we place arsphenamin and spirochetes together in a test tube, we find that the spirochetes are not affected. The reasons for the good results so far reported from direct application to the ulceromembranous lesions have not been explained satisfactorily as yet. The number of investigators who have isolated and cultivated spirochetes is very limited, which explains why our knowledge in this particular field is so meager.

The chemically pure sodium perborate, recommended by Bloodgood,[12] and also recommended in the last report of the White House Conference on Child Health and Protection as the "most specific" for prevention and treatment, may be mentioned here. As the pharmacologic properties of all these agents and their effect on the gum tissue or on highly inflamed areas are not definitely known, the use of them, with the exception of neo-arsphenamin, sulfarsphenamin or emetin, cannot be wholly recommended. A preparation, therefore, which is based on scientific studies and most of the pharmacologic properties of which are known is to be welcomed.

At the beginning of this paper, I referred to the different pharmacologic properties of camillosan and the expectation that employment of this preparation would be attended by favorable results in cases of Vincent's infection. My experience over a period of years in the use of preparations of camillosanum liquidum has confirmed these expectations. Its antiphlogistic effect is outstanding. We have treated altogether about forty cases of Vincent's infection, and we observed, after a thorough local cleaning and an application of either the ointment or the liquid form of camillosan on the inflamed gingiva, that the inflammatory symptoms were relieved in a surprisingly short time, sometimes within twenty-four hours. The ointment has the advantage of remaining much longer on the mucosa or in the interdental spaces. It should be applied to these surfaces after they are thoroughly dried in order to produce thereupon the maximum effect. The liquid is diluted after a short time by the saliva, which decreases its effectiveness.

The treatment with the concentrated form of camillosan is carried out in the following manner: The solution is applied drop by drop on the carefully dried gum tissue, in pockets or on ulcers, the mouth being kept open for several minutes. It is advisable to protect the areas from saliva by means of cotton rolls, thereby allowing the camillosan to exercise its astringent, analgesic and antiphlogistic powers. In severe cases, this procedure should be repeated two or three times daily. The results are conspicuously successful.

When progress in healing was observed, the spray method of application was used. We employed a solution of 1 to 2 tablets of camillozon in 50 c.c. of lukewarm water, applied by means of the spray attachment of the dental unit. The small atomizer is especially useful in home treatment, since it does not require compressed air but uses carbon dioxide. This produces better circulation in the mucosa, as well as cleansing and massaging locally. It must be emphasized that the spray should not

12. Bloodgood, J. C.: Oral Lesions Due to Vincent's Angina, J.A.M.A., 88:1142 (April 9) 1927.

be used at the onset of Vincent's infection because this treatment causes too much pain and may lead to an aggravation of the condition. It is advisable to use the spray during the convalescent period, and care must be taken never to direct its force into the pocket but always in the direction from the apex to the crown of the tooth. When the tissue is not sensitive, the spray can be directed through the interdental spaces. This cleanses areas which cannot be reached by the toothbrush, a factor which has special value in the treatment of the gingivae in Vincent's infection.

Professor Entin,[13] Leningrad, was successful with this method in the treatment of marginal paradentitis. He reported that cyanosis and suppuration quickly disappeared after three or four irrigations with camillosan. The subjective symptoms also improved in a surprisingly short time.

The effect of camillozon spray lies in the happy combination of camillosanum liquidum with hydrogen peroxide. The latter has an excellent bactericidal effect of which we should take advantage in all acute inflammatory processes. The injury to the epithelial layer usually caused by the use of hydrogen peroxide is counteracted by the combination with camillosan. We, therefore, have in this preparation an agent whose properties are almost invaluable for the treatment of all acute irritated conditions of the mouth mucosa, as well as of all chronic inflammations. It is a specially useful agent also in prophylaxis in cases of pathobiotic susceptibility of the gingiva.

13. Entin, D. A.: Zur Frage der Pathogenese der marginalen Paradentitis, Deutsch. Monatschr. f. Zahnh., 48:656 (April 15) 1930.

We have prescribed camillosan liquidum in a number of cases for a daily mouth wash, especially when the patient complained of severe halitosis. This symptom is present in all cases of Vincent's infection. Camillosan has the advantage of not producing discoloration of the teeth, even though used several times daily.

The sensitiveness of the gingiva existing in most cases of Vincent's infection was alleviated by camillosept, which will be discussed more thoroughly under periodontitis and gangrenous pulps. The treatment consisted in touching the gingiva several times at intervals with this preparation. All sensitiveness was eliminated in a very short time.

SUPPURATIVE PARADENTOSIS

Everything that has been said in the foregoing section of this paper regarding the camomile treatment of Vincent's infection is also true for the suppurative forms of paradentosis. The suppuration is the expression of an infection, which must be combated. Whether the infection is a primary or a secondary one in paradentosis will not be discussed. Furthermore, whether this infection leads to ulcerative changes or is limited to a slight "catarrhal" gingivitis or a paradentitis is of minor importance. In all cases, the primary therapy must consist in supporting the organism in its efforts to combat the inflammation and in fortifying the tissue cells, and not in weakening them by the application of deleterious drugs.

Camillosan seems to fulfil these requirements. In Vincent's infection, as well as in the suppurative forms of the diseases of the paradentium, we secured good results with preparations containing camillosan. My own experience and results with these new preparations en-

tirely confirm the publications of Loos,[14] Weski,[15] Entin,[13] Sachs,[16] etc.

In the treatment, severe cases of inflammatory paradentosis were selected for the most part, and from these we preferred to choose those cases which had not responded to conservative treatment over a long period of time. Those of the periodontists and practicing dentists who are especially interested in consideration of the etiology and pathogenesis of paradentosis will understand that not every case will react to treatment with medicaments on account of the extraordinary variety of causes of this disease. For instance, if anomalies in position of the teeth, or deep pockets of 5 or 6 mm. are present, or if there are such conditions as an overstress of single teeth, grinding of the teeth at night or the presence of overhanging fillings or margins of crowns, constant irritation to the gingiva results. In order to evaluate the effect of the medicaments, all cases were classified into different groups in accordance with the above mentioned conditions.

The inflammatory type of paradentosis, due to uncleanliness in local areas of the gingival margin, perhaps the result of lack of hygiene or proper brushing, healed after a thorough treatment with both instruments and medicaments in a surprisingly short time. Controls were introduced in a few cases by treating only one part of the mouth with camillosan after instrumentation. The difference in healing time amounted sometimes to one or two days.

When complicated conditions were present, the healing process progressed more slowly. In almost all cases, it could be recognized that treatment with this remedy effected a decided acceleration of the healing process, surpassed only by that resulting from the use of chromic acid. The treatment with 10 per cent chromic acid, which I preferred in the past to accompany the instrumentation, showed that, for unknown reasons, certain cases do not respond. From the very frequent desquamation of the superficial epithelial layers of the gingiva following treatment with chromic acid—which varies with the individual—chromic acid probably is not the ideal remedy in gingival therapy since its use seems to lead frequently to injury of the epithelial cells, the result being the antithesis of what was desired. This is also true of many other agents which have found favor with the dental profession. The epithelial and connective tissue cells, the resistance of which is already lowered by the inflammatory processes, are further injured through these agents; which renders these tissue cells useless in combating the inflammation. The result of the treatment is failure.

In almost all cases that did not respond to chromic acid therapy, we found that treatment over a period of several days with one or another of the camillosan preparations resulted in alleviation of the condition. The pharmacologic properties of the blue oil, which is a constituent of camomile, seemed to be responsible mainly for this success. The improvement of the gum tissue was obvious, a healthy appearance being regained within a short time, even in very stubborn cases.

14. Loos, Otto: Gesichtspunkte in der Kamillosantherapie, Zahnärztl. Rundsch., No. 13, 1931.

15. Weski, Otto: Beiträge zur Indikationsfrage in der Paradentosebehandlung (Kamilletten), Zahnärztl. Rundsch., No. 36, 1927; Kamillosan und Kamillozon, Lecture, 8th Internat. D. Cong., Paris, 1931.

16. Sachs, H.: Sieben Jahre Erfahrungen mit Kamillosan, Zahnärztl. Rundsch., No. 40, 1930.

The procedure in the use of camillosan varied. After each instrumentation, which must precede medication in all cases of suppurative paradentosis, we applied the concentrated camillosanum liquidum as described in the paragraph on the treatment of Vincent's infection. In some cases, we limited ourselves to one such treatment and observed good results. In others, we chose to supplement this with a mouth wash of camillozon or even very thorough massage with camillosan ointment. In any event, in all severe suppurative cases, it appears to be advisable, as far as our experience indicates, to ask the patients to wash the mouth thoroughly with a solution of camillosan, 1:10, every two hours for two days. Camillosan tablets, which can be dissolved in one-half a glass of water, are a convenient form for patients. The taste of the preparation is agreeable to most patients.

We secured especially good results in the treatment of the gum tissue with camillosan ointment. As a result of the experimental examinations of Heinz, we know that the etheric oils have a high vapor tension and evaporate within a short time at room temperature. Lipoid solubility and volatility are further properties which enable the etheric oils to penetrate all cells easily. They are soluble in oils, natural fats and lipoids and can, in turn, dissolve them. This explains why they are able to penetrate the uninjured skin and mucous membranes of the body. The pharmacologic properties of blue oil seem especially efficacious when the treatment includes thorough massage of the gum tissue, which also stimulates circulation in the tissue. The epithelium is damaged less than by other preparations, as, for instance, hydrogen or alcohol massage, and the patient can easily massage his own gums at different times daily, which is a great advantage.

In order to bring the ointment as nearly as possible in contact with the inflamed tissue at the bottom of the pocket, we have used with great success the Vastine method, pushing the ointment into the pockets with a rubber cup and hand pressure. This procedure can be recommended in connection with the camillosan ointment. It is, of course, necessary that the field of operation be thoroughly dried, as otherwise the ointment would not adhere.

It may be emphasized especially that, of course, camillosan in its different forms cannot by any means replace instrumentation and that it does not promise success in cases of paradentosis resulting from systemic disease. Such a panacea for all types of paradentosis does not exist as yet and probably will never be discovered. The advantage of these preparations lies in the fact that, on account of the pharmacologic properties, we now have a remedy which is absolutely "tissue friendly," and which differs from all other known agents in that their action is either caustic or bactericidal. Camillosan is nonirritating and has only a very slight bactericidal activity, which is a minor consideration. Its antiphlogistic property constitutes its main value, and this is not at the present time surpassed by that of any other product.

The statements of Tholuck,[17] first Secretary of the Hygiene Commission of the F. D. I., on the prophylaxis of paradentosis may be of interest here: "The camillosan therapy which relies on a pharmacologically well approved, exactly dosable, and absolutely nonirritant remedial agent, may therefore be with justice

17. Tholuck, H. J.: Modern Mouth Hygiene, Pub. D. Gaz., 5, No. 2, 1930.

described as the basis of modern mouth hygiene."

APHTHOUS STOMATITIS

Recently, we had several opportunities to observe the effect of concentrated camillosan in cases of a recurrence of aphthous stomatitis. The mouth mucosa was carefully dried and the lesions touched with a cotton pellet dipped in concentrated camillosan. The patient was advised to wash the mouth every two hours with a 10 per cent solution of camillosan or with a solution made from two of the above mentioned tablets in one-half to one glass of water. The canker sores, which had persisted for several days or a week sometimes, lost their extreme sensitiveness within a few hours and usually disappeared entirely in two or three days. The customary intermittent occurrence of the lesions was prevented by the regular use of this solution as a mouth wash. No recurrence was observed after the beginning of the treatment.

PERIODONTITIS; GANGRENOUS PULPS

Finally, another indication for camillosan in dentistry may be discussed to which Oehrlein,[18] of the College of Dentistry in Riga, has referred. In summarizing, he said:

> Camillosan can be applied with excellent results in the treatment of all wounds and diseases of the mucosa of the mouth. In the treatment of root canals, it is especially useful because of its nonirritating qualities, particularly where the periodontium is sensitive. There is absolutely no danger in its use and it can, therefore, be given to the patient for home use without restriction even in concentrated form.

For the root canal treatment, the before mentioned sterile solution of salicylic phenyl ester in lipoid soluble camomile constituents is especially indicated.

Recently, Hauenstein[19] has reported on his experience with this preparation (camillosept). He found that it was especially good in the treatment of root canals because of its oily consistency, which causes it to adhere to the walls and facilitates the passage down to the apex. In one and one-half years, he treated approximately 700 or 800 cases of periodontitis of all kinds and about fifty cases of putrescent pulp. He reports that only a short time after the application of camillosept, the symptoms disappeared. In numerous cases of distinct periodontitis, acuta apicalis circumscripta with severe subjective symptoms, caused by an infected pulp, he produced very good results in a short period. Injuries of the periodontal membrane, due to medicaments, were also successfully treated. Symptoms of apical periodontitis, spontaneous pain and pain resulting from percussion and chewing disappeared immediately.

The pain which sometimes follows root canal filling, as troublesome to dentist as to patient, was alleviated very quickly, according to Hauenstein, as a result of camillosept therapy. In slight cases, he applied the camillosept to the area affected. In cases of severe pain, submucous injection of 0.2 per cent solution proved to be very efficient. It was similarly used in the treatment of traumatic irritation of the periodontal membrane or marginal forms, which are often found as a result of the presence of overhanging fillings and also in accidental perforation with periodontic pain fol-

18. Oehrlein: Kamillosan, Zahnärztl. Rundsch, No. 43 and 44, 1923; Kamillosan in der zahnärtztlichen Praxis, Deutsch. Monatschr. f. Zahnhlk. No. 12, 1925.

19. Hauenstein, K.: Die Verwendung der Kamillenpräparate, besonders des Kamillosepts, in der konservierenden Zahnheilkunde, Deutsche Zahnärtzl. Wchnschr., No. 3, 1932.

lowing. Because root canal fillings are favored by European dentists, Hauenstein was encouraged to use camillosept in the treatment of putrescent pulps. He confirmed the statements of Grimsehl[20] that, in the treatment of cases of gangrene, the deodorant effect of this preparation was especially advantageous. It acts as an indicator of the progress of the treatment. Camillosept seems to be a valuable addition to dental medicaments for use in cases of acute and chronic periodontal diseases.

Summarizing, we can say that camillosan, because of its "tissue friendly" properties, seems to have a wide field to which it may be applied in dentistry and will serve excellently in the treatment of infectious processes in the oral cavity.

In general medicine, camillosan has also found application in the last few years. It is being used in different types of catarrhal intestinal disease and in cases of dysentery (Bode, Kowalzig[21]); furthermore, for irrigation in the treatment of colitis membranacea and colica mucosa. The effect, which is mainly analgesic and sedative, is much more pronounced than was the effect secured with the old infusion form. The mucous and hemorrhagic discharge in the stool is rapidly decreased, and reports have been made of the bactericidal effects, which are conspicuous in the treatment of patients suffering from dysentery.

In gynecology, camillosan is used, especially in the form of a cream, for the prevention of mastitis. Large abdominal wounds and those of the mammae in mastitis, even in case of extensive secretion, showed, under camomile treatment, distinct decrease of secretion, as well as good formation of granulation tissue and rapid epithelization. Cases of intertrigo with severe itching and burning, which had resisted other treatment for a long period of time, were cured by the application of a thin layer of camillosan cream (Seitz, Weinsheimer[22]).

In pediatrics and dermatology, camillosan has been used with success in the treatment of intertrigo, rhagades, phlegmons, burns, even those of second degree, chilblains, furuncles, anal fissures, moist eczema and puritus (Moro[23]).

The pharmacologic properties, which have been discussed, explain why the therapeutic possibilities of camillosan are not limited to these divisions of general medicine. In surgery and ophthalmology, as well as in otorhinolaryngology, successful treatment with camillosan has been reported, which is only mentioned in passing.

The foregoing paragraphs are written with the intention of acquainting the dental profession of this country with the various methods and applications of the newly discovered camomile treatment. Many experiences in the treatment of infectious processes in the oral cavity with camillosan during the past few years have confirmed the reports of success in all divisions of medicine and dentistry in other countries.

20. Grimsehl: Kamillosept in der Zahnheilkunde, Zahnärztl. Rundsch., No. 6, 1930.

21. Kowalzig, H.: Erfahrungen mit Kamillosan, einer neuen Anwendungsart der Kamille, München. med. Wchnschr., 69:49 (Jan. 13) 1922.

22. Weinsheimer, K.: Ueber Kamillosan Salbe, Klin. Wchnschr., No. 5, 1923.

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PROLONGING THE EFFICIENCY OF SERVICE FROM PROSTHETIC DENTURES*

By WALTER H. WRIGHT, D.D.S., M.S., F.A.C.D., Pittsburgh, Pa.

RECENT studies on the behavior of denture-supporting tissues have shown that most changes in these tissues tend to impair the efficiency of service from prosthetic dentures. Changes in denture-supporting tissues continue throughout the life of the patient, and likewise the efficiency of denture service gradually decreases throughout the life of a denture.

The effect of changes which occur in the mouth under a full denture may be illustrated by comparing the masticatory mechanism, first, with a building, and, secondly, with an automobile.

In comparing dentures with a building, we find that both are constructed upon a foundation. The dentures, in a majority of cases, rest upon a resilient mucous membrane which is constantly changing, the building upon a stone or concrete foundation which is not expected to settle or change. In spite of precautions in construction, the foundation under a new building may change and require refitting of the doors and windows in order to restore efficiency. If these corrections and alterations are frequently necessary in buildings which rest upon stone foundations, is it not logical to assume that corrections and adjustments are universally required by dentures which rest upon the changing mucous membrane of the mouth?

In comparing a set of dentures with an automobile, we find a favorable analogy. Both are assumed to be properly made, and yet both require more or less adjustment before they reach the peak of their efficiency. Shortly after this efficiency peak has been reached, both the dentures and the automobile show a gradual decrease in efficiency, which continues, unless corrected, until each is no longer serviceable. Here the analogy ends, for the automobile which makes an appeal to the owner's pride or which jeopardizes the lives of his family is hurried to the repair shop, while the dentures are expected to continue to give efficient service for at least forty years, if not during the entire lifetime of the patient. When we compare the sturdy mechanism of an automobile with the delicate supporting tissues of the human mouth, we begin to realize the responsibility which rests with the dental profession in prolonging the efficiency of service from prosthetic dentures.

Perhaps I shall tread on controversial ground in stating my opinion that the dentist's responsibility barely begins when he inserts a new denture in the mouth of his patient; further, that it is his duty to examine and to correct the denture throughout its period of usefulness with such honesty and interest that the patient will respect his judgment when

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he suggests that the old denture has outlasted its usefulness, and that a new one should be made. Without this mutual understanding and cooperation, there can be no real denture service.

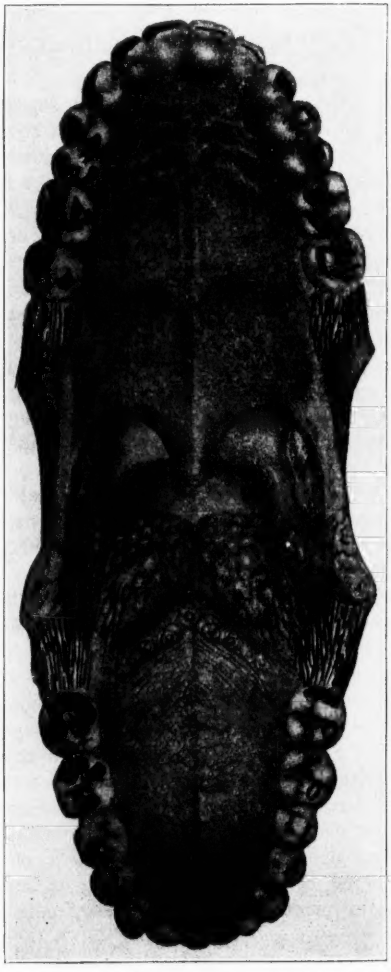
This view of denture service is quite contrary to the current "plate making" idea in dentistry held by some who find a ready harvest in quickly making and inserting dentures, trusting to the ignorance of the patient or the kindness of Nature to tolerate them, even though the dentures are, for the most part, improperly made, and then "orphaned" by the maker.

The traditions and ideals of the profession, the health and comfort of the patient, the constant changes in denture-supporting tissues, and the dentist's moral responsibility all cry out against the evils of such practices.

The responsibility for prolonging denture service lies with the dentist. He alone knows the changes which are invariably associated with denture service. It is his duty to instruct his patients regarding the results of wearing dentures so that they may be better able to detect changes when they occur, and to avail themselves of the corrections which the dentist is prepared to make.

It is a sad commentary that an intelligent citizen will hurry his eight-cylinder automobile to the service station when it misses on but one cylinder, while, at the same time, he may be wearing, with apparent unconcern, a denture in which twenty-five of twenty-eight teeth may be missing contact during mastication.

I do not blame the patient for his indifference toward denture service. He is not trained to detect the minor changes in the fit and function of dentures, and, further, these changes occur so gradually that he, through force of habit, becomes used to them. Frequently he continues to wear dentures which, in addition to being unserviceable, may be actually harmful to the anatomic structures of the mouth.



Facet markings on teeth of full upper and lower prosthetic denture. Food was masticated on the left side and not on the right, where the facets are well defined and highly polished.

I conclude that these unsatisfactory conditions exist because dentists generally are neither qualified to correct the defects which occur during the wearing of dentures, nor do they take time to instruct the patient regarding the changes which may occur and the corrections which may be required.

I find that patients, when properly instructed, will avail themselves of service. In fact, they insist on it, and are willing to pay a reasonable fee for the maintenance of denture service just as they are accustomed to pay for the servicing or repair of household appliances or an automobile.

Two statements by Hanau which clearly define the problem that confronts the dentist who renders denture service are as follows:

"Occlusal changes which occur in any particular jaw relation may be temporary during function and permanent where tissues under dentures have changed."[1]

This statement is further explained in the following:

During the life of a prosthetic denture, complications enter the problem of associating occlusion and jaw relations in the mouth. The entire problem cannot be solved by the skilful technician who simply applies the laws of articulation to the arrangement of the teeth in the articulator, for here one encounters no particular functional complications because of the rigid plaster-of-Paris mounting of the denture bases upon which the teeth are set up. The functional complications of our denture problem really begin with a consideration of "realeff" and changes of the denture bearing tissues together with an inquiry into the functional relation between the rigid articulator mechanism and the anatomic apparatus.[1]

PURPOSE

My experience is not unlike that of numerous practitioners who have suffered the keenest disappointment at the failure of their most carefully made restorations shortly after they had been inserted and worn by the patient. I shall attempt to point out the common cause of such failures and also to encourage many who have come to regard this phase of denture service as almost hopeless.

In the following data, I propose to show that (1) changes in the denture-supporting tissues are detrimental to denture service, (2) the average patient is not aware of tissue changes and their detrimental effect on denture service, (3) dentures should be corrected periodically to compensate for the effects of tissue changes and (4) the patient can be instructed to recognize defects in service, and to appreciate the necessity for efficient denture service.

MATERIALS AND METHODS

The observations leading to the presentation of this paper, which have been made during the past three years, involve several hundred patients, each of whom I have examined and questioned, recording the findings on a chart that contains a list of questions, which are to follow. The length of individual denture service varied from three to eighteen months.

In each case, the conditions present after the wearing of dentures were compared with a record of conditions existing at the time that the dentures were made. The original record was made on a chart shown in Figure 1.

BODY

Examination.—The dentures were first examined in the patient's mouth and the following questions were asked:

General appearance:

Do your dentures resemble your own teeth?

Are you pleased with the appearance?

Do your friends like the appearance of your dentures?

1. Hanau, R. L.: Occlusal Changes in Centric Relation, J. A. D. A., 16:1903 (Oct.) 1915.

Do they say that your dentures look natural?

Retention:

Does your upper denture ever come loose or drop when you talk, smile, laugh, yawn, whistle, sing, swallow or chew?

Does the lower denture come loose during the same test?

Are you satisfied with the fit of your dentures?

Jaw relation, occlusion:

Do your teeth come together evenly all around when you lightly close them together?

When you close the teeth together do you have to slide the teeth slightly to make them come together evenly?

Mastication:

Do you chew on the right, left, or both sides?

Do you ever chew food without your dentures?

Can you chew all kinds of foods satisfactorily?

Fibrous foods?

Do food or seeds get under your upper or lower dentures?

Service:

Are your dentures giving service as good as you had expected?

How does this service compare with that of your own natural teeth?

Denture hygiene:

What cleaning material do you use on your dentures?

How often do you clean them?

Do you ever clean them while they are in the mouth?

Do you have difficulty in keeping them clean and pleasant to the smell and taste?

Deficiencies:

In what particular respect could your dentures be improved? If you were to have them remade would you want to make any changes in the new set (either by adding to or taking away from the present set)?

Tissue conditions:

Have you noticed any soreness under your dentures?

Patient's experience:

How did you feel when dentures were first inserted and worn?

How did you overcome these early difficulties in wearing dentures?

Do your dentures now feel natural?

Do you ever forget that they are artificial?

Taste:

Do you notice any difference in taste?

Do you believe that the upper denture affects your taste?

What have you learned about wearing dentures that may be helpful to another denture wearer?

Health:

Has your health improved since wearing dentures?

In what respect?

The dentures were then removed from the mouth and the polished facets on the masticatory surface of each tooth were examined. Frequently, a record of these markings was recorded on a sketch of the teeth shown in the accompanying figure, which is contained in a chart employed in the University of Pittsburgh Dental School, department of clinical prosthesis and previously reproduced.[2] These markings will be discussed later.

In order to summarize this study, I shall limit this report to the answers given by approximately 100 patients during the current year:

1. Appearance: More than 95 per cent of these patients were satisfied with the appearance of their dentures.

2. Retention: Thirty-four per cent of the upper dentures and 46 per cent of the lower dentures were lacking in regard to retention, yet more than 90 per cent of the patients were satisfied with the poorly retained dentures. Some patients reported that the denture had gradually become loose, while others did not notice the looseness.

3. Centric relation and occlusion: Fifty per cent of the dentures were found to require correction of the occlusal relations, and yet more than 90 per cent of the patients were unable to detect the unbalanced occlusal relations. After the occlusal relations of the dentures had been corrected, virtually every patient

2. Wright, W. H.: Aid to Prognosis in Full Denture Service: Preliminary Data, J.A.D.A., 15:1893 (Oct.) 1928.

was able to detect the improvement in the occlusal relations.

4. Mastication: Thirty-six per cent masticated on the right side, exclusively, 24 per cent on the left side and 40 per cent on both sides. (One patient who formerly masticated on the right side changed to the left side after his right arm had been amputated.) Eighty-five per cent testified that they were able to masticate all kinds of foods satisfactorily, even though 50 per cent of the dentures were unbalanced and in spite of the fact that seeds tended to get under 63 per cent of the lower dentures and 9 per cent of the upper dentures during mastication.

5. Service: More than 90 per cent were getting as good service from dentures as they had expected and 32 per cent asserted that this service was better than that of their own natural teeth.

6. Hygiene: The dentures were cleaned on an average of two and two-thirds times each day, with cleaning materials which varied from soap powder to clear water. Nine per cent cleaned the dentures in the mouth and 19 per cent had difficulty in keeping them clean.

7. Deficiencies: Patients noticed the looseness of the lower denture and the unnatural appearance due to resorption more frequently than any other defects.

8. Tissue conditions: Thirty-five per cent of the mouths showed different types of irritation of the supporting tissues which could be corrected only by the dentist.

9. Patient's experience: Ninety-four per cent of these patients had been uncomfortable when learning to wear dentures. They all overcame that difficulty by persevering in wearing them and their dentures now feel natural. In fact, 67 per cent frequently forget that they are wearing dentures. All but two had found that the secret of learning to wear dentures is to put them in and wear them.

10. Taste: Twenty-one per cent had noticed a difference in the taste of food, which was found to be caused by (1) failure of food to touch the hard palate and (2) loss of thermal conductivity due to the presence of the upper denture. The sense of taste was not impaired, but the associated sense of touch rendered it less acute.

11. Health: The health of 67 per cent of these patients had been improved by wearing dentures. Headaches, indigestion, arthritis and loss of weight were the principal conditions which were corrected by wearing dentures.

The foregoing summary clearly indicates that (1) at least 50 per cent of these dentures required correction of the occlusal relations within eighteen months after they had been made and worn by the patient and (2) 95 per cent of these patients were apparently satisfied until they were informed that the dentures could be corrected and thereby rendered more serviceable. Some patients reluctantly permitted the correction of their dentures, but later were greatly pleased with the improvement which at first they had thought impossible. Most of these patients, although unaware of the deficiencies of their dentures, described the improved dentures as "feeling like they did when they were new," and requested that they might return for similar corrections in the future.

Diagnosis.—Having outlined the features which were observed during the examination, I come to the more difficult phase of the diagnosis of these conditions preparatory to corrective treatment. I desire, first, to point out the value of studying the facet markings on

the teeth of the denture and, secondly, to enumerate the common deficiencies which may be evidenced during denture service, together with suggestions as to their cause.

1. Facet markings on the teeth of prosthetic dentures: The small, and often disregarded, facets shown in the accompanying figure are, in my opinion, the most important factor in determining what kind of service the dentures have been giving and what corrections may be necessary to prolong the usefulness of the restoration.

To begin with, facets confirm in a positive way the fact that occlusal relations change as resorption of the denture-supporting tissue occurs. In a relatively short time, polished facets begin to appear on the mesial inclines of the cusps of the lower teeth and likewise on the distal inclines of the cusps of the upper teeth.

As resorption occurs, the upper denture settles into the maxilla, while the lower denture settles into the mandible. The mandible, therefore, closes farther in order to occlude the dentures, and thus the lower denture is carried forward on the arc of a circle, the center of which is located in or near the temporomandibular joint. After this loss of intermaxillary space and the moving forward of the lower jaw, the teeth occlude in protrusive occlusion instead of centric occlusion. In this relation, the mesial inclines of the cusps of the lower teeth strike the distal inclines of the cusps of the upper teeth, and the polished facets bear witness to this abnormal relation. Forward pressure is thus exerted on the upper denture and causes anterior displacement of this denture, together with looseness of the postpalatal margin.

Another characteristic feature of these facet markings is observed in the fact that they are more polished and pronounced on the balancing side of the denture than on the working side. This is caused by the teeth coming together on the balancing side, while on the working side the teeth strike the bolus of food. The facets, therefore, show the functional movements of the patient and frequently lead to the discovery that one side of the denture is better balanced than the opposite side. Usually, the patient will masticate more effectively and habitually on the right side if the left side is in balancing contact, or vice versa. Unless the balancing side of a restoration is in balanced occlusion, that side of the upper or lower denture will tend to become loose when the patient masticates on the opposite side. The habits of the patient are readily deduced from an examination of the facet markings on the teeth of dentures, after which these observations may be confirmed in the mouth and by questioning the patient.

In addition to important evidence gained from the facet markings of the teeth, the following guide has proved of considerable value in determining the causes of inefficient denture service. To this guide may be added those items which have been found to aid in solving the perplexing problems relating to denture service.

2. Guide to diagnosis: (*a*) Discomfort from dentures may be caused by:

1. Displacement of and impingement on tissue by tightly fitting denture.

2. Overextension of denture borders and margins or underextension of the postpalatal margin of the upper denture.

3. Roughness of the unfinished surface of the denture.

4. The presence of spiculae of bone, or sore spots in the patient's mouth.

5. Poor adaptation of a denture, causing abrasion.
6. Malocclusion resulting in traumatic conditions.
7. Biting of the cheek, lips or tongue.
8. The size and form of the denture.
9. Temporary increase in flow of the saliva.
10. Temporary impairment of the sense of taste.

(*b*) Loss of retention may be due to:

1. Faulty adaptation of the denture to the supporting tissues owing to faulty impression or warpage.
2. Overextension of borders or margins.
3. Underextension of borders or margins.
4. Faulty marginal seal.
5. Unbalanced occlusion.
6. Temporary reduction in size of the tissues owing to the physical condition of the patient.
7. Lack of or too abundant flow of saliva.
8. Quality of the denture-supporting tissues.
9. Habits of the cheeks or tongue which dislodge a denture.
10. Leakage through a defect in the denture.

(*c*) Inability to masticate may be caused by:

1. Unbalanced occlusion associated with correct or incorrect jaw relations.
2. The presence of inefficient cusp and tooth forms.
3. Loss of retention.
4. Discomfort.
5. The insufficient denture experience and lack of perseverance and determination on the part of the patient.
6. Physiologic or anatomic defects in the masticatory apparatus.

(*d*) An undesirable esthetic effect may be caused by:

1. The intermaxillary denture space being too great or too small.
2. Lack of harmony in color, form, size and positional arrangement of the teeth.
3. The outline, contour and color of the dentures.
4. Lack of harmony in form, size and relationship of the jaws and lips.

(*e*) Unbalanced occlusion may be caused by:

1. Incorrect registration of centric jaw relationship.
2. Occlusal changes due to resorption of the supporting tissues.
3. Loss of retention of the dentures.
4. Overextension of borders or margins of a denture.
5. Failure to establish balanced occlusion when the denture was first made.
6. The presence of an inharmonious compensating curve, tooth and cusp form for the requirements of the condylar guidance, overbite and overjet.
7. Uncontrollable resilience (realeff) under a denture base.

(*f*) Gagging and nausea may be caused by:

1. The physical condition of the patient resulting from disturbance of the digestive system.
2. Overextension of the postpalatal margin of the upper denture.
3. Underextension of the postpalatal margin of the upper denture.
4. A loose fitting at the postpalatal margin of the upper denture.
5. Overextension of the lingual borders of the lower denture.

(*g*) Difficulty in swallowing may be caused by:

1. Reduction of the height of the denture space.

2. Increase of the height of the denture space.

3. The use of dentures which are too bulky.

4. An insufficient flow of saliva.

5. Lack of perseverance on the patient's part.

(*h*) Imperfect speech may be caused by:

1. The denture margins interfering with the muscles of the tongue or lips or the moveable portion of palate.

2. The use of upper teeth which are too long, too short or too far toward the labial or the lingual aspect.

3. The use of lower teeth which are too long, too short or too far toward the labial or the lingual aspect.

4. The constriction or enlargement of the arch form of the upper teeth.

5. Abnormal conditions of the lips, residual ridges or tongue, preventing a normal arrangement of the teeth.

6. Crowding of the tongue by the lower denture.

7. The dentures being too bulky or too thin, especially in the palatal portion of the upper denture.

8. Loss of retention.

9. An improper length of denture space of the upper or lower denture.

10. Inexperience.

Treatment.—A brief survey of the means at the dentist's disposal in restoring efficient service follows. In order to simplify this presentation, I shall tabulate the processes together with the conditions which may be corrected by each.

1. Cleaning and polishing: All dentures which have been worn by the patient should be cleaned and polished at frequent intervals, whether further corrections are needed or not.

2. Simple adjustment: Burring, sanding and polishing may be required when it is necessary to eliminate: overextension of denture margins or hard areas, roughness of denture surfaces and denture borders which are too bulky.

3. Spot grinding: Minor occlusal discrepancies may be eliminated by spot grinding without remounting the dentures on the articulator. Which teeth are to be ground may be determined by the use of articulating paper, by observing the interference in the mouth or by interpretation of the patient's tactile sense. When the cheeks or lips are being bitten, the overjet of the upper tooth should be increased by grinding the buccal or labial surface of the offending lower tooth.

4. Remounting on the articulator: This procedure is frequently followed when the occlusal relations must be corrected while they are still within correctable limits. These discrepancies may be due to resorption, or to an error in obtaining correct centric relation when the dentures were made. It is also recommended following relining, resetting or remaking of dentures, since the vulcanization process tends to cause discrepancies of the occlusal relations.

5. Rerimming: Underextension, or faulty adaptation of the denture borders, and margins may be corrected by rerimming.

6. Relining: Relining an old denture may correct the following conditions: loss of retention due to poor adaptation of the denture to the seating surfaces of the jaw, warpage, minor discrepancies of the occlusal relations due to resorption of denture-supporting tissues and reestablishment of the proper denture space.

7. Resetting: A denture may be reset when it is satisfactory in regard to every feature except the base material of which it is made. This process is consequently very seldom required.

8. Repairing: A fractured denture base, holes caused by wear and missing teeth are restored by suitable methods involved in the repair of dentures.

9. Remaking: When defects are impossible of correction by the foregoing methods, the denture should be remade. The need for major corrections of occlusal relations, associated with poor retention or closing of the denture space is sufficient reason for a remake. Likewise, the correction of color, form, size or arrangement of the teeth or a change in the denture base materials calls for remaking of the denture.

SUMMARY

1. Denture-supporting tissues are subject to change.

2. These changes destroy the efficiency of dentures.

3. The average patient is not aware of tissue changes or of the effect of tissue changes on denture service.

4. Patients can be so instructed as to recognize deficiencies in denture service and to appreciate the necessity for having old denture defects corrected.

5. Dentures must be examined and corrected at frequent intervals in order to prolong efficient service.

6. The dentist is responsible for instructing the patient in the necessity for correction of denture defects arising during service.

7. There are numerous procedures at the dentist's disposal for making inefficient dentures satisfactory.

DISCUSSION

Floyd G. Rea, Brooklyn, N. Y.: One must of necessity agree that changes do occur in the supporting tissues of dentures in most instances, but not that they occur in all instances, nor to the same degree in all cases where evidenced. Neither does one find the latter conditions in all cases positively detrimental. A comparison of dentures with a building resting upon a foundation is perfect, for both are resting upon supports which are not a part of them. The sustaining medium in both instances may lack a certain amount of resistance within prescribed limits. In comparing dentures with an automobile, there is not the same analogy, as an automobile is a machine which is subject to the bane of all mechanism, namely, friction. Moreover, comparison of the sturdy mechanism of an automobile to the tissues of the mouth may be questioned when consideration is taken of the fact that the oral tissues function every day throughout a lifetime, with natural dentition, and, in some cases, later with artificial dentition, and it would be indeed a rare automobile that would run every day for from fifty to 100 years. I do not feel that the dentist's responsibility has only begun when he inserts a new denture in the mouth of a patient. It should be his responsibility to construct a denture so that all conditions of function and esthetics are restored as nearly as possible, to see the patient a sufficient number of times that all necessary adjustments may be made for both comfort and function, and to instruct the patient fully concerning the limitations of oral tissues and the vulnerability of dentures to minor accidents. He should explain the necessity for periodical visits to his office for mouth examination, occlusal balancing and polishing. All subsequent responsibility rests squarely upon the patient. If he does not care or choose to return, no effort on the part of the dentist can cause him to do so without a considerable lowering of professional dignity. How many of us have seen the so-called intelligent citizen who takes meticulous care of his automobile, keeps his house in good repair, patronizes a good tailor and preserves his external appearance, yet ignores the fact of ill-fitting dentures or carious or infected teeth which are not giving so much discomfort as to become too annoying. Moreover, it has been my experience to see patients wearing a half of a fractured denture and managing to get along with it for months or even years, and these were not persons who could not afford to pay. I hold no brief for "plate making" and do not defend unqualified dentists, for I realize that in a large percentage of dentures in existence today there was no more thought of scientific construction than is necessary to take very mediocre impressions and a wax bite and send them to a laboratory, whereupon

upon equally poor dentures are constructed. Nevertheless, I do not recede from the position that most patients feel that when dentures are finished, they have no more responsibility and should not again be called upon to pay for anything, even the repair of fracture in some instances. As far as the purpose, examination, diagnosis, chart-forming and treatment outlined here are concerned, I can give only my unbounded approval, for it should be apparent to all that this work has been a major advance in denture service, and one which should be patterned after to the fullest extent possible. A striking part of the findings are the polished facets and the story they tell. If the Utopia of denture service is ever reached, I feel that it should result in the construction of new dentures for the patient at intervals of not greater than every three years.

R. H. Kingery, Ann Arbor, Mich.: Because of the completeness of this paper, little can be added; because it has a practical application, it is within the realm of general practice; because of the proof obtained by examination of patients, it can hardly be questioned. In reviewing Dr. Wright's summary, we realize that denture-supporting tissues change, with the resulting loss of denture efficiency. We must also admit that the average patient is unaware of this fact. I doubt the advisability of training the patient to recognize defects. Explain the mouth changes if you wish, but leading patients, especially those of the neurotic type, to look for defects will cause mutual unhappiness. Adjustment of a denture at frequent intervals will most surely give the honest operator an opportunity to maintain the efficiency of the case. The dentist's responsibility in instructing the patient as to the necessity for correction is of utmost importance if we are to carry out the suggestions of this paper. The ideas presented for prolonging efficient denture service will never be carried out as long as we use the term "permanent dentures." By using this term, we have led the public to believe that when teeth are removed and dentures inserted, no further dental service is needed throughout the life of the patient. We know that anything which gains its support from tissues subject to change cannot be permanent. Consequently, when a patient presents himself for dentures, the operator should eradicate this idea of "permanent dentures" and outline for him the changes to be expected. We may use the analogy of the automobile, or whatever you wish, but the patient must realize that if he wishes to receive maximum service and to avoid extreme changes in facial expression, he must frequently have his dentures examined, corrected or even remade. When an operator makes a prognosis regarding structural changes, he should also outline the cost of service. This mutual information not only promotes more conscientious effort on the part of the operator, but also prevents misunderstanding later. The owner of the automobile pays for service on his car; the denture patient should be willing to pay for service if he is informed of its need in advance. People are giving more attention to their physical well-being. Each year, a greater number seek regular physical examinations. People welcome information pertaining to the preservation of their health, and what is more necessary than proper masticatory efficiency?

Dr. Wright: Dr. Rea's objection to comparing dentures with an automobile is well founded. I tried to point out, not the similarity between dentures and an automobile, but the patient's attitude toward the service rendered by each. I agree with Dr. Rea that dentures must be properly made. In stating that "the dentist's responsibility is only begun when he inserts a new denture," I did not infer that the steps preceding the insertion of dentures should be slighted. I tried to make clear that a dentist's responsibility does not end when he inserts a new denture in the mouth of a patient. It is understood that the patient must be willing to return for subsequent adjustments and corrections. I believe that I am correct in stating that the patient is usually quite willing to return for any adjustment or correction which may add to his comfort and increase the usefulness of his dentures. Dr. Kingery has pointed out, and I agree with him, that mutual unhappiness may result from instructing patients to look for defects in dentures. I tried to convey the idea that every patient who wears dentures should know in a general way those conditions, such as loss of retention, discomfort, difficulty in mastication and altered appearance, which frequently are associated with the wearing of dentures. Neurotic patients will discover these conditions without the dentist's help, but the average patient may be expected to avail himself of this service only if he is conscious that he needs it.

ROENTGEN INTERPRETATION AS A GUIDE IN GENERAL EXODONTIA*

By FREDERICK F. MOLT, D.D.S., Chicago, Ill.

THE use of the roentgenogram in modern exodontia practice may be considered in three phases: preoperative, operative and postoperative.

After the discovery of the roentgen rays, their introduction into medical practice and their gradual acceptance in dental procedures, the greatest impetus to our more general dependence on the dental roentgenogram has been the formulating and acceptance of the theory of focal infection. In diagnosis, as a consequence, we are searching more often than not for a potential focus of infection. The association of pulpless teeth and advanced pyorrheic destruction as factors in certain systemic malfunction has been stressed so frequently as not to require repetition. The remote relation of such conditions as contributory to a generally lowered resistance and, therefore, calling for elimination for the general well-being of the patient is a problem that frequently requires even more serious thought.

The too prevalent opinion that the roentgenogram is the last word in oral diagnosis is deserving of some comment, as is the too ready acceptance of any roentgenogram, good, bad or indifferent, for diagnostic purposes. We should have, primarily, an interpretable roentgenogram. This demands completeness, that all areas be sufficiently portrayed for interpretation and be of a proper texture, in order to make possible the comparison of "values" in radiolucence and radiopacity, on which interpretation depends. It is not possible to obtain equivalent density and contrast in all oral roentgenograms, nor should we attempt to do so, for bone density varies perceptibly from case to case, while tooth structure has always essentially the same roentgenographic density. In consequence, the comparative radiopacity of bone and tooth must necessarily vary. Knowing this and possibly making slight deviation in exposure time to compensate for added tissue penetration in the "heavy" patient, the operator may use a so-called fixed or standardized technic to provide an added diagnostic feature, the comparison of bone density from case to case. McKevitt[1] has pointed out the advantages of this standardized roentgenographic technic in a recent contribution in which he classifies bone texture as normal, hypocalcified or hypercalcified. There is, of course, no well defined line of demarcation between the classes.

In the standardized technic, a fixed penetration is used, 70 Kv. peak, or approximately 4 inches penetration. The other undeviating factors are the target distance, the processing and, with the exception of the slight timing advance for the corpulent patient, the timing. The variable factors are, of course, the positioning of film and patient, each case differing with conditions.

*Read before Section on Oral Surgery, Exodontia and Anesthesia at the Seventy-Fourth Annual Session of the American Dental Association, Buffalo, N. Y., Sept. 14, 1932.

1. McKevitt, F. H.: Atrophy and Hypertrophy of Maxillary and Mandibular Alveolar Process and Their Effect on Stability of Artificial Dentures, J. A. D. A., 19:424 (March) 1932.

Overexposure and underexposure, improper positioning, underdeveloping, the use of a too cold, too old or too warm developer and improperly lighted dark rooms are the chief elements in the production of inadequate or noninterpretable oral roentgenograms; all of which faults may be guarded against by the exercise of reasonable care.

No more adequate panorama of the dental and alveolar structures has been presented than that of McCormack. In this technic, there are several marked differences from the usual roentgenographic procedure. Special double-coated films are used, of a much faster emulsion than the so-called "commercial" packets, and a 36 inch target distance is used for all exposures, in contrast to the usual end-of-cone distance which may be from 8 to 12 inches. Certain advantages accrue from this combination. The added target distance not only obviates a great amount of secondary radiation, but also is particularly helpful in "throwing out" the malar shadow in upper molar exposures. The rapid emulsion makes possible a very short exposure time in spite of this unusually long target distance. From eighteen to twenty-two films are used to cover the entire mouth and, with extra-oral lateral jaw check-ups of the mandibular third molar and retromolar areas, leave little undisclosed.

Having produced a satisfactory and sufficiently complete oral roentgenogram, we next turn to its study. While its prophylactic, or preventive, use in discovering incipient caries and periodontoclasia is of primary importance, this paper, being concerned with its use in exodontia, must pass this by for the gross deviations indicating, possibly, the need for extraction or more extensive surgical measures. It is as important that the roentgenograms be properly viewed as that they be of proper texture to be studied. In attempting to interpret either the too light, underexposed or underdeveloped, or the too dark, overexposed or improperly washed, film much that is of value may be utterly lost, to the patient's detriment. The chief reason for roentgenographing a mouth being to do away with guesswork, we should not be compelled to "guess" because the films are not readable. The viewing box used should be of the type permitting of varying the lighting, not to accommodate it to various kinds of films, but to permit of studying even the clearest one with different degrees of illumination. A good reading glass, held in the hand, not at a fixed distance, will permit of enlarging each area studied and will give a surprising amount of "depth" and contrast to the roentgenogram, essentially the equivalent of those of films stereoscopically made and viewed.

That there are variations in normal anatomy must be kept in mind as well as the routine anatomic deviation in radiopacity and radiolucency, the interpretation of which as being abnormal or pathologic is too frequently made. One attempting a diagnosis should, therefore, be familiar with the roentgenographic appearance of nasal spine and fossae, median suture, anterior palatine foramen, canine fossae, maxillary sinuses, malar processes and posterior palatine foramina in the maxilla, and of geniohyoid tubercle, incisive fossa, mental foramina, inferior dental canals and mylohyoid grooves in the mandible. He should realize that the size of the anterior palatine foramen may vary from that of a pinhead to that of a good sized pea and still be "normal"; that the undulations of the sinus floor

may extend down between and even definitely overlap upper bicuspid and molar root ends; that the coronoid process of the mandible may be shown in the upper third molar area if the mouth is sufficiently closed; that the depth of the canine or incisive fossae and of the mylohyoid groove may be so extreme that the radiolucency will simulate pathologic destruction of great extent, and that the mental foramen may be found anywhere from below the apex of the first bicuspid to below and between the roots of the first molar. In the reading of posterior-anterior and lateral head and jaw plates, the infra-orbital canal may appear as a line of fracture, or the overlapping of spine and jaw may suggest a fracture of the mandible.

A mandibular area lacking in cancellations, owing possibly to the influence of some systemic disease, may be interpreted as pathologic; whereas, a comparison with the roentgenograms of the opposite side of the mandible will show that there an identical situation exists. Such a comparison should be made when the canine fossa suggests pathologic destruction as well as in the cases of exceedingly deep mylohyoid grooves. In both these conditions, as well as in extreme radiolucence underlying the lower anterior teeth, palpation during clinical examination of the mouth will be of help in making a decision.

This clinical examination, the second step in effecting a diagnosis, may corroborate or contradict the roentgenographic findings. It may offer nothing of value; or it may by itself, in certain cases in which the roentgenogram has given us no information, permit of a diagnosis.

A consideration of the symptoms as observed, described by the patient or elicited by questioning, the history of the case as far as it is obtainable and a comparison with previous roentgenograms, if available, will all throw light on the case. These with a complete clinical examination and the roentgenographic interpretation will usually permit of a definite diagnostic statement —an oral diagnosis.

The decision as to what constitutes a pathologic focus seems to be as far from being stabilized as it was ten years ago. It is not surprising that the layman's conception of disease should be expressed in terms of "pus"; hence, "abscess" and "pus pocket" mean something to be gotten rid of, while any roentgenographically negative tooth, no matter how long pulpless or how odoriferously putrescent before being "treated," is ignored. What wonder, since many physicians cannot and many dentists will not recognize that, under certain systemic reactions, such teeth, in spite of no "abscess" being shown, are definitely potential sources of infection, and that "retreatment" will not in any degree change the situation.

Usually, the general diagnosis is entirely the medical consultant's prerogative, the oral diagnosis the dentist's and the association of the oral findings with existing systemic malfunction a matter to be determined by consultation of the two. This requires that both be competent diagnosticians and each sufficiently open minded to recognize the other's problems, both considering chiefly the well-being of the patient.

Simpson is responsible for the term "radiographic clairvoyance" in its application to the dental diagnosticians who can tell by viewing the roentgenogram whether any existing pulpless tooth or periapical mass is "harmful"

or "harmless"; in other words, whether pathologic or nonpathologic. As a matter of fact, they must all be considered guilty until proved innocent. It frequently requires the same type of clairvoyance to determine whether the destroyed bone area is occupied by a granuloma, peri-alveolar abscess or cyst, as they are necessarily overlapping conditions and may, in their transitional stages, partake of the nature of either one. If only the presence of a destroyed periapical area (and then only sometimes) indicates a source of infection and if only the removal of the existing granuloma or sac is necessary to free the tooth from suspicion, apicoectomy would in all cases be all that was needed. The history of focal infection, studies and research does not substantiate such a hypothesis.

Such stress has been placed on "residual areas of infection" that many operators have gone to an extreme in curetting every "suspicious" area. If it be recognized that the removal of any periapical mass coincidently with the extraction of the causative tooth or teeth will obviate the possible need for a subsequent operation, many of the so-called residual areas of infection will be avoided. Removal means complete elimination, not the desultory scratching around in the socket that so often is designated curettage. It should always be kept in mind that regeneration requires from six months to one year and that, if the tissue mass has been left *in situ,* its natural obliteration may require even longer. Therefore, one should not be too hasty in diagnosing a radiolucent area as evidence of "residual infection," when only a month or two have elapsed since operation.

Cases are frequently encountered in which too diligent curettage, the attachment of the mass to the periosteum or a past apicoectomy has left an area in which no regeneration will ever occur because the periosteum has been entirely destroyed. Only fibrous tissue will form in such an area, and a roentgenogram six months or six years after operation will look identically the same. A new consultant, oblivious to or not obtaining the history of the case, may plunge into a new operation because of "residual infection," with no possibility of benefit to the patient.

A radicular cyst or a perialveolar abscess that is in process of becoming cystic may remain as a cyst after the tooth that has been its source has been extracted, if, of course, the sac has not been removed by curettage. As a consequence, we find these residual cysts in many edentulous areas and frequently involving vital teeth in adjacent areas. These enlarge by extension and pressure atrophy of the surrounding bone. There is little chance for confusion as to the existence of such a cyst, except that when one encounters an excessively large or irregular maxillary sinus floor in the dental roentgenogram, particularly when the sinus has a septal division, there is frequently a question as to whether it is a cyst. A lateral head roentgenogram with lipiodol injected into the sinus will serve to settle the question, or, simpler, the opening of a buccal mucoperiosteal flap and the exploratory puncture of the area through the buccal process will clarify the diagnosis. Usually, an extensive cyst in such a position will show an enlargement or there will be the characteristic eggshell crackling on palpation.

Other conditions — osteitis fibrosa cystica or adamantinoma — may simulate and readily be mistaken for such a residual type of cyst.

A cyst of the follicular type, developing from the epithelial tooth follicle,

may originate in connection with an impacted or malposed tooth, from the follicle of a tooth development of which has been arrested, or even from the retained operculum of an extracted submerged tooth. On this basis, not only should all third molar areas be roentgenographed after the normal period for the eruption of these teeth has elapsed and the teeth are missing, but also the operator removing a submerged tooth should be careful to tear away the epithelial enamel sac in completing the operation to avoid later cyst development.

Another vital diagnostic problem is associated with impacted teeth. There is no requirement that all impacted teeth be removed just because they are impacted, yet frequently one would suspect that there is. On the contrary, there are vast pathologic and neurotic possibilities in the retention of any such tooth. After the roentgenogram has been made, these should be carefully considered in connection with a study of the clinical and symptomatic findings.

Although it is held by some authorities that all impacted teeth are infected, this is decidedly open to question in the case of completely buried teeth. If there is the slightest aperture in the epithelial covering of the tooth crown permitting ingress of mouth fluids, one can definitely say that an infection exists. This may be latent and may never have caused the slightest pain or swelling, yet must be considered in the same category, potentially, as the pulpless tooth with the periapical abscess or granuloma. This is particularly true of the "submerged" tooth, which, except for being incompletely erupted or exposed, is not necessarily "impacted." The presence of such teeth is among the most dangerous findings in oral roentgenograms. While an epithelial covering of normal thickness need not excite suspicion, teeth of this type will usually show an excessively thick sac and, if so, should be investigated. If the clinical findings confirm the appearance in the roentgenogram, it is the part of wisdom and an excellent prophylactic measure to advise extraction at once. Particularly in such cases should as much of this sac or "pericoronal abscess" as possible be removed in the course of the extraction.

In many cases, a long retained impacted tooth will be found to have caused absorption of the root of the adjacent tooth — another point to be considered in the diagnosis — and when such a condition exists, it will be wise to include that tooth in the extraction. Occasionally, the extraction only of the absorbed tooth is indicated, permitting the eruption of the impacted tooth. The age of the patient is a determining factor in such a decision.

Many young patients show what is apparently a well defined impaction. The advice of the orthodontist as to the extraction or retention of such a tooth is of the greatest value, as, while in some cases such teeth retard or upset the orthodontic procedure, in other cases the pressure and support of the third molar is essential to the satisfactory progress of orthodontic work.

In determining the buccolingual position of a mandibular third molar and its relation to the second molar either for diagnosis or in anticipation of operative interference, there is much value in the so-called occlusal view made by inserting a film between the upper and lower teeth — sensitive side down, of course — closing the teeth on it and then directing the ray upward as nearly as possible along the long axis of the second molar. This requires added penetration or timing, or both.

An equivalent technic may be used

in localizing impacted cuspids or supernumerary teeth. Upper impacted cuspids in fully 95 per cent of cases lie lingually from the other anterior teeth. In an occasional case, such a tooth will be immediately above the incisors or the root may extend diagonally toward the buccal aspect over the bicuspid root ends. Such information obtained in advance is advantageous.

It is frequently difficult or impossible to distinguish in the roentgenogram between retained roots and sclerotic bone masses of similar size and shape. If the removal of every possible source of infection, no matter how remote, is imperative, all roots should be eliminated. Often, only an exploratory operation, opening down to the body, will determine which is shown. It is extremely doubtful that sclerotic bone masses have any pathologic significance.

Débris of filling material — amalgam or cement usually — that has been held in a socket and covered over, or of guttapercha that has been forced through a root apex and left in the socket after extraction, is difficult to reach, locate or remove. It is usually for the patient in precarious health that the removal of such débris is called for. In the abscence of landmarks, in edentulous or partly edentulous mouths, it is frequently possible to exactly locate roots or such débris by inserting a portion of a metal hypodermic needle in the tissue on the buccal side of the ridge in the approximate site and reexposing the area with this as a marker. The needle is permitted to remain, then, until the patient returns to the operating room, and the measurements are made from that point.

Generally speaking, distortion should be avoided if possible. Foreshortening is usually to be preferred to lengthening. Extreme lengthening of a tooth image throws the apex out of focus, frequently to such a degree that it cannot be seen at all. Occasionally, distortion is desirable; for instance, in showing the apices of an upper molar when the malar process is low and the palate very flat. In such a case, it may be necessary to lengthen the image perceptibly or hold the film for exposure in a more nearly perpendicular position by placing a cotton roll between the film and the teeth.

The determination of comparative bone calcification has two diagnostic aspects: (1) in its relation to predenture diagnosis and prognosis, as to the probable rapidity of absorption under dentures, and (2) in relation to the possible difficulties to be encountered in accomplishing any indicated extractions. In hypocalcified bone, even the extraction of a hypercementosed tooth does not present so much of a problem as may the extraction of a straight rooted pulpless tooth in a hypercalcified jaw. If the examination of the mouth discloses a heavy gingival ridge on the buccal aspect, and particularly if the pulpless tooth is shown to have the pericemental line obliterated, as is frequently the case with teeth long pulpless, these facts, in association with the brittleness common to all such teeth, lead us to anticipate difficulty in the tooth removal.

McKevitt points out, incidentally, that both hypercementosis and cyst formation develop to greater extremes in hypocalcified jaws than in normal or hypercalcified cases, presumably because so little resistance is offered by the lightly calcified osseous structures.

Acute infections cannot be revealed by the roentgenogram. There is, of course, no difference in the roentgenographic appearance of a vital and of a pulpless

tooth the canals of which have not been filled or that show no periapical destruction. In consequence, the film may be of little value in such cases, although it may show one tooth to be open to suspicion or suggest one of two or three. A resort to clinical examination and classic symptomatology may be our only recourse.

Osteomyelitis may result from a flaring-up of a retained infection, from a pulpless tooth with or without previous periapical destruction, from a pyorrhea pocket or from external sources. Pain may be intense before the roentgenogram can show any bone change; but when this structural deviation does occur, it will manifest itself by a grayish semiradiolucence. The involved area may be approached either by extracting an involved or an adjacent tooth and carrying a drain into the affected cancellous bone, or by drilling or cutting through the compact bone wall to this point for the same purpose.

Pain of other types may include simple toothache, the offending tooth being readily segregated by the roentgenogram, or it may be of the neuralgia type, in which case, aside from disclosing conditions that may be remotely associated, the film may be of little value. Many cases of neuralgia are attributable to impacted teeth.

Obviously, the major use of the roentgenogram has been covered in the diagnostic or preoperative sense, and in planning an extraction procedure. The only additional operative use would be that of checking the progress of a difficult operation, determining whether a root has been completely removed, or its location if it has not. It is simpler and infinitely preferable, assuming that it is not necessary to let the patient wake up from a general anesthesia in order that an exposure be made, to determine in this way how close we are to completion of the procedure and what the deterrent may be, rather than to dig blindly into a jaw with forceps or elevators in the fatuous hope that we may eventually get the root out. Many roots will be kept out of maxillary sinuses, many inferior dental canals be kept intact and many contiguous teeth keep their supporting bony structures, if such a precaution is resorted to.

It has been stressed that complete removal of the tooth is imperative, yet an occasional broken off, attenuated root of either a maxillary or a mandibular third molar, lying in or almost in either antrum floor or inferior dental canal, may be left for removal until after Nature has in some degree moved it toward exfoliation. The patient should, of course, know that this is being done, and why.

The postoperative use of the roentgenogram comprehends a checking-up for our own satisfaction or for the purpose of demonstrating to patient or physician (or both) that the work has been completed.

A reexamination record of a jaw after removal of one of the extremely difficult impacted mandibular third molars is a comforting thing to have in one's file, for no matter how conscientious and careful the operator, an occasional patient is bound to have some criticism to offer or some question to raise. Cases have been known in which the family physician has been quick to attribute postoperative swelling to "broken jaw," and malpractice suits have been built upon just such ill-advised and unjustified statements. It is not beyond the bounds of possibility, as well, that some other dentist, unrestricted by considerations of ethics or honesty, may attribute postoperative pain to an incomplete or

unsatisfactory extraction, with a like unfortunate sequel. Therefore, if there is any question as to the results, by all means let us turn to the roentgenogram for its disclosures and for confirmation of our success.

The material here presented is necessarily in a great part repetition and reiteration. A conservative element in the profession has been at all times reluctant to accept the disclosures of the roentgenogram and we have heard many times the statement that "the x-ray lies." Unquestionably, because of distortion, overlapping or imperfect exposure or processing, it is possible to show an apparent condition that does not exist. The great fault lies in the diagnostician who is poorly versed in anatomic deviations, too assiduous in overinterpreting films or content to depend on incomplete or poorly made roentgenograms. As a diagnostic adjunct, it is invaluable, yet it is not infallible; and it does not supplant clinical diagnosis: it is only one portion, and as such should be highly regarded.

There is surely no reason that the roentgenogram's disclosures of abscessed root apices or of failing bridges, crowns, etc., should be accepted by either patient or dentist as a reflection on his efforts, if it is assumed that he is capable and has been conscientious and thorough. We are working with vital structures, and no matter how honest the work, its lifetime or its invulnerability cannot be guaranteed. Under such circumstances, particularly when major health problems are involved, it is desirable, even imperative, that diagnosis and surgical measures be equally complete. No one factor will contribute in a greater degree to success than the roentgenogram and omission to use it may subject both dentist and physician to criticism.

25 East Washington Street.

DISCUSSION

Menifee R. Howard, Denver, Colo.: The use of the roentgenogram is invaluable in a search for the potential focus of infection within the oral cavity. In a search for the four common causes of dental focal infection; namely, apical disturbances, pyorrhea alveolaris, impactions and residual areas, the roentgenogram is a necessity. Without it, we would be groping about in the dark. In order to be properly interpreted, the roentgenograms must be taken at correct angles and be properly exposed and developed to present contrasts. The roentgenogram should cover a slightly larger field than the area under observation, including the crown and root of the tooth and the normal contact of the interproximal surfaces. For proper systematizing and study of general average density, the McCormack method referred to seems to be ideal. The Simpson method, which requires a little additional time, suggests developing the first roentgenogram immediately, while the patient remains in the office. When this is done, it is possible to ascertain the bone density. The amount of penetration and the time of exposure may be made to suit the case. The single radiotized film in the commercial packs seems to present a better contrast than others of similar types. After the required number of roentgenograms are taken, a careful study is made with the aid of a lamp made for the purpose. This is preferably done without the patient present. At this time, there is a correlation of all findings in order to tabulate a complete diagnosis. Dr. Molt has covered the anatomic relationships in detail. It is well to emphasize a common error; that is, the confusing of the mental foramen with a pathologic area, especially if it happens to be located adjacent to the apices of the bicuspids. Dr. Molt has referred to the anterior palatine foramen showing an enlarged condition as not being pathologic. In a few cases of enlargement, this foramen, on being opened, has been found to be pathologic, the process sometimes extending into the nasal septum. In such cases, in addition to the roentgenogram, other diagnostic aids should be employed. The only other aids referred to by Dr. Molt, in association with the dental roentgenogram, are clinical and classic symptoms. The use of the vitalitest and transillumination

was not emphasized. In my opinion, the examination of the oral cavity is augmented by use of the various aids at our disposal, such as the vitalitest and especially the application of ice to each tooth. These supplements allow an additiooal check on the roentgenogram. Some cases from routine practice show apical radiolucent areas in the roentgenogram in regions not mentioned by Dr. Molt. As an illustration, radiolucent areas at the apices of vital teeth may be due to traumatic occlusion. Other teeth may prove pulpless by vital test, when such condition is not discernible by clinical examination, or by the roentgenogram, nor are they revealed by classic symptoms. Transillumination, while not to be depended on too much, has its value. As a preliminary aid to the roentgenographic examination, it may reveal the presence of foreign bodies, congested areas or antrum complications. It may be helpful in certain cases of pulpless teeth and residual areas. Often, all of these tests are made, one acting as a check on another. In such cases, opportunity is afforded to recheck when there is conflict in diagnostic symptoms. Radiolucent areas do not always represent pathologic conditions. It is generally known that the so-called abscess sac or granuloma is not visible in the roentgenogram, but what is actually seen is the radiolucent area produced by the absorption of bone tissue, which is due to the existing pathologic condition. Dr. Molt states that 95 per cent of cuspid impactions lie toward the lingual aspect. My observation is that in more than 50 per cent of cases, the tooth lies diagonally from the lingual to the buccal aspect, the crown usually lying lingually and the root extending over the bicuspid teeth toward the buccal aspect. In operation, they are removed from these respective positions. About 50 per cent lie entirely on the buccal aspect and the remainder strictly on the lingual. When the dental film is placed in position, a suitable size piece of sterile gauze is preferred to cotton as suggested by Dr. Molt. In emphasizing the roentgenogram as a valuable aid in general exodontia, it may be well to stress its value in making a diagnosis. It reveals pathologic conditions, density and amount of bone, the shape of roots and hypercementosis. It is also valuable postoperatively, disclosing the condition of the socket and area of operation. If the fact that dental focal infection plays such an important part in the health of the body is taken into consideration, this checking up is advisable in order that all tooth roots, foreign bodies and broken process may be removed and pathologic conditions eliminated. In addition, postoperative roentgenograms are valuable in convincing the patient that the operation has been thorough and complete. In my opinion, the roentgenogram is an invaluable aid in general exodontia and should be used in nearly all cases both preoperatively and postoperatively. Thus, we will be enabled to do our work more carefully and thoroughly and to establish greater confidence in our patients.

Harry Bear, Richmond, Va.: It is important to reiterate that it is in the preoperative field that the roentgenogram is of greatest value. The comparative ease with which the technical procedures for making a roentgen-ray examination can be carried out has been a distinct disadvantage. It has encouraged those with no experience and others who are indifferent to the matter of careful examination to take so-called "pictures"; and because an image of some kind was discernible on the films, to regard them as entirely acceptable. The novice and the inexperienced will render a diagnosis from poorly made films; whereas, competent and experienced practitioners would hesitate even to venture an opinion. It cannot be stressed too forcefully that a roentgenographic examination is only an aid in diagnosis: the clinical findings are of major importance. A competent diagnosis is dependent on the correlation of all of these findings. The roentgenographic findings may not reveal positive evidences of a pathologic condition. Negative findings or any variations from the normal, as Dr. Molt points out, are equally important diagnostic aids. There is no room for debate or argument in outlining the necessity for careful roentgenographic examinations preceding operative intervention. It is sometimes necessary to make a further roentgen-ray study during an operation. This is a conservative practice and should be followed where indicated rather than an attempt at completion of an operation with a feeling of uncertainty present. A postoperative roentgenogram proves to be of decided advantage in many cases. It would be desirable to consider its use a matter of routine.

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Editorials

A NEW LIGHT ON TOOTH DEVELOPMENT

In the article by Logan and Kronfeld published in this issue, it will be noted that the findings on the beginning of calcification of the permanent teeth are at considerable variance with current opinion. By turning to Table 2, and comparing the order of beginning calcification as announced by different authors, quite a discrepancy will be found. For instance, we note that the central incisor is listed from the first month to the first year, and the lateral incisor from the first month to the second year. By some authors, the bicuspids are said to begin calcification the first month; by others, it is given as the fifth year, which seems almost too great a discrepancy. While doubtless there may be considerable variation in different individuals, a study of this table will at once demonstrate the fact that there have been some loose estimates on the part of certain men of the past.

One of the unexpected findings in the table of Logan and Kronfeld relates to the sequence of calcification of the upper lateral incisor and the upper central incisor and the cuspid. The two

latter begin calcification at from three to six months; the lateral incisor, at from one year to fifteen months. According to this finding, the central incisor and cuspid begin calcification perceptibly in advance of that of the lateral incisor, a sequence which is entirely different from that given by previous writers on this subject. In nearly all of the charts that have been published from the earliest times till now, the impression has been conveyed that the sequence was relatively as follows: central incisor, lateral incisor and cuspid, and this may be true of the lower jaw, but it is assuredly not true of the upper jaw. The upper lateral incisor begins to calcify approximately nine months later than the upper central incisor and the cuspid, though the upper and lower central and lateral incisors may erupt at nearly the same time. Thus, a prevalent misconception that has existed from the earliest recorded data has at last been cleared up, and the authors of the present paper are entitled to the thanks of the profession.

Another peculiar observation relates to the behavior of the bicuspids. At birth, the germs of the bicuspids are small epithelial buds lying on the occlusal surfaces of the crowns of the deciduous molars. In the third year, they begin moving toward the roots of the deciduous molars, and by 4 years of age, they are finally found located between the diverging roots of the corresponding deciduous molars. Thus, the bicuspid germs describe a complete half circle around the deciduous molars from the occlusal aspect, on the lingual side, to their final position between the roots of the molars.

An interesting phenomenon may also be noted in relation to the attachment of the zygomatic arch. At birth, the zygomatic process approximately overlies the second deciduous molar germ, but later the maxilla grows forward as well as backward from the attachment of the zygoma so that the zygomatic process is found in the area of the first permanent molar, and the second and third permanent molars are unmistakably behind the zygoma.

The deciduous and permanent germs lie in a very crowded condition within the maxilla, almost every tooth overlapping its neighbor; which is of special importance in histology, children's dentistry and surgery and in the problems of nutrition and devel-

opment. All in all, it is apparent that the recent demonstrations are sufficiently revolutionary to call for a somewhat radical revision of our ideas on the question of tooth development. We are very sure that the authors of this paper will want to have their findings checked by other investigators to see whether there may perchance be still further light thrown on the subject. Nothing is ever quite final in the realm of scientific research, and the real student is the one who glories in the establishment of a new fact even when that fact may displace a preconceived theory of his own.

A TIE-UP WITH THE U. S. PUBLIC HEALTH SERVICE IN THE MATTER OF DENTAL EDUCATIONAL PUBLICITY

Under date of Nov. 3, 1932, a committee was appointed from the Board of Trustees by the President, G. Walter Dittmar, to draft rules and regulations for the conduct and control of dental educational publicity. This committee, consisting of Drs. C. E. Rudolph, W. O. Talbot and C. Willard Camalier, chairman, at once went to work, and at the recent meeting of the Board of Trustees in February, a report of progress was made.

A plan was suggested to place the work of publicity in the Central Office of the A.D.A. rather than in some outside agency where it might be difficult of supervision. The Bureau of Public Relations seemed the logical channel through which this activity could function, particularly in view of the fact that much of the material to be employed is already available in the Central Office.

Meanwhile, under direction of the President, an approach was made, through Dr. C. T. Messner, to enlist the interest of the U. S. Public Health Service in the matter of supervision or suggestions as to the character of the material to be sent out. In line with this idea, Surgeon-General Hugh S. Cumming, of the U. S. Public Health Service, was approached. Dr. Cumming responded promptly with a letter in which he tendered his cordial support of the activity, stating that as soon as the necessary plans were con-

summated, he would designate an officer of the Public Health Service to work with the A.D.A. in developing a nation-wide educational campaign.

This tie-up between an important governmental agency and our own Association is of the utmost importance, and will result in great benefit not only to those immediately concerned, but in a larger and more utilitarian sense to the public at large, whose welfare, after all, is the prime incentive in any effort of this nature.

THE AMERICAN DENTAL FOUNDATION INCORPORATED

Announcement was made at the recent annual meeting at Buffalo of the formation of the American Dental Foundation, Incorporated. This activity has been in process of formation for four years, and the leading spirit in its development has been Dr. Edward H. Bruening, Trustee from the Eleventh District. Dr. Bruening has given much time and effort toward formulating the necessary plans, and to him is largely due the final consummation of a movement that has within it the germ of great possibilities.

The idea is to encourage leading dentists, philanthropists or organizations of any kind to donate funds for the purpose of building the Foundation, and particularly to urge dentists to make bequests in their wills to augment the fund.

Dr. Bruening aptly says: "Many dentists are willing to give much energy, thought, time and money for the benefit of their fellow practitioners and their profession during their lifetime. They attend dental meetings, local, state, national and foreign. They pay dues and otherwise contribute liberally to various funds. They serve as officers and on committees. They take part in charitable enterprises. They carry on educational work. They cooperate in activities and campaigns to help place dentistry on a higher plane, and they demand that it be given the recognition it deserves. They believe in dentistry and are willing to fight its battles on any ground and in any place. They wish to contribute to the advancement, even after death, of the profession

they have learned to love; and it is for these men that the Foundation was organized, to provide an opportunity for those who so desire to will to the profession funds for the support of its activities. In making bequests, the donor may designate the department in which he is most interested and the fund will be turned over to the Foundation, to be used for that specific purpose."

With an opportunity like this, what is more natural than that the philanthropic members of the profession will want to make provision in their wills for the support of this Foundation? The idea should make an appeal to every friend of organized dentistry, and let it be said that the phrase "organized dentistry" has come to mean something as the years have gone on.

The suggested beneficiaries of the Foundation include such enterprises as education, child welfare, research, economics, publications, library and the American Dental Association home.

According to Dr. Bruening: "The men who will supervise the expenditures will be of undoubted integrity. They have had many years of experience in the various activities of dentistry and will fulfil every trust placed in them. Great care has been exercised to protect all interests that might be concerned in the conduct of the affairs of this Foundation."

To this end, the Foundation was incorporated according to a plan approved by competent legal authority, and the welfare of the profession has been safeguarded in every possible way. It is now prepared to begin functioning.

In accordance with the prevalent tendencies of the age in the building and distribution of the proceeds of foundations, it is the intent that the principal fund shall be exhausted in twenty-five years.

The following were elected incorporators and the first board of directors: Drs. H. J. Burkhart, C. E. Rudolph, George B. Winter and C. N. Johnson. There will also be on the board one representative each from the American Association of Dental Schools, the Research Commission, the Relief Commission, the Committee on Dental Health Education and the National Research Council.

What a splendid thing it would be if this foundation could build up a fund of sufficient proportions to announce to the profession and the world that we have men of vision and acumen who can inaugurate a movement that will set a mark for other professions to follow! It is an opportunity for a gesture that will put dentistry definitely in the foreground and it will prove that, in addition to our achievements in the science and art of our calling, we can think of something broader and more enduring for the future welfare of humanity.

OUR ASSOCIATE EDITOR

At the Memphis meeting in 1931, in the Editor's report, a recommendation was made for the employment of an associate editor, and a committee was appointed to formulate plans for bringing this about. At the recent meeting of the Board of Trustees, in February, a report was made by the committee consisting of Drs. George B. Winter, chairman, Thomas L. Grisamore and Wilfred H. Robinson.

The Committee recommended the name of Dr. Newton G. Thomas of Chicago as Associate Editor, and the Board of Trustees duly elected him. Dr. Thomas comes to the Association with a fine reputation as a man of distinguished ability in several fields of endeavor. He has been a teacher, a research worker and a writer, and in all three he has shown a splendid capacity for work of this type.

With his natural bent toward research, it was the idea of the committee that his chief service, in addition to a general cooperation with the work of THE JOURNAL, was to be in connection with a research journal, publication of which is contemplated in the near future in the natural expansion of the Association's activities. A periodical of this character has long been needed, and now that there is promise of an early consummation of the plans for its development, the way seems to be paved for a greatly increased service to our members.

We welcome Dr. Thomas to the editorial staff.

RESCINDING THE ORDER

In our issue of February, 1933, we noted the passing of an order in the Navy Department changing the designation "Dental Service" to "Stomatological Service," in "Organization Tables, Hospital Orders, Hospital Memoranda and otherwise."

An emphatic protest on the part of our profession at once followed the announcement of this order, and now we are happy to note that this order has been rescinded, and the former designation of "Dental Service" has been reinstated. This reinstatement was a very wise move on the part of our Naval authorities, and we hereby tender our congratulations to the officers of the Navy, and particularly to the Surgeon General, through whose kindly offices the reinstatement was made.

HENRY BARNES
(1851-1932)

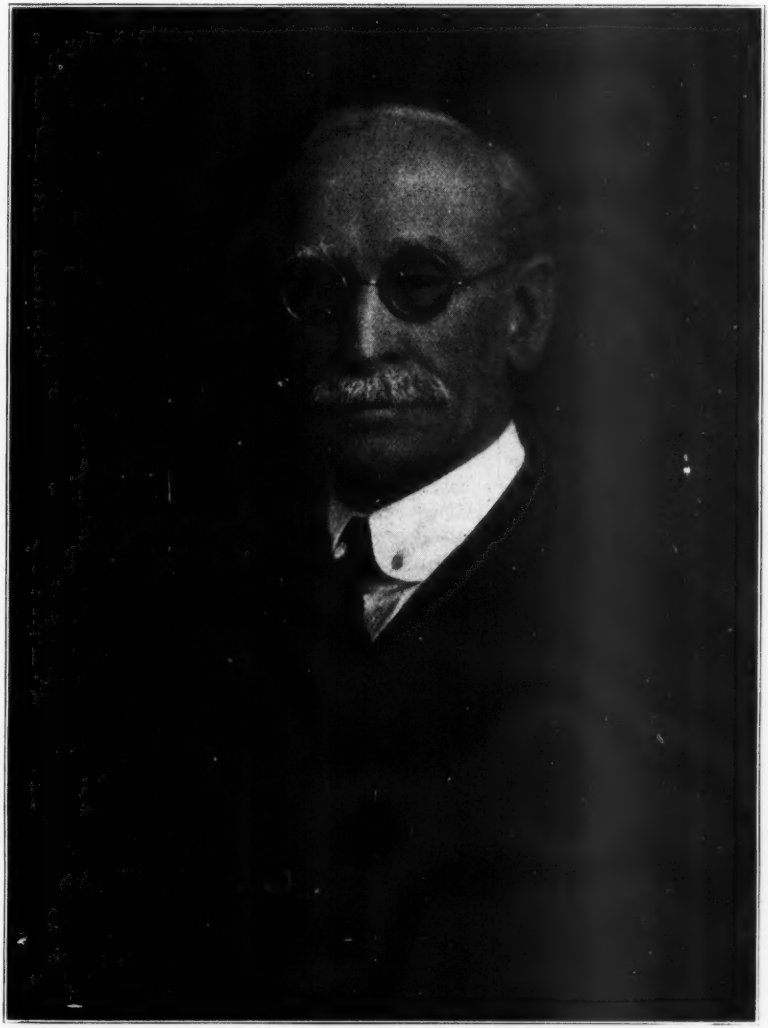
Henry Barnes was born in Stockfort, England, April 15, 1851. He came to the United States with his parents in 1853, residing in Pawtucket, R. I., and later in Fall River, Mass. In 1870, he went to Cleveland, where he studied dentistry under John Stephan and anatomy under Prof. H. W. Kitchen until 1873.

Dr. Barnes practiced in Marquette, Mich., 1873-1877, and while there studied medicine in the office of George H. Northrop. He returned to Cleveland to practice and attend lectures at Wooster Medical College. In 1879, he was licensed by the Ohio State Dental Examining Board. In 1892, he became professor of dental anatomy and technic in the dental department of the Homeopathic Hospital College, where he received the honorary degree of doctor of medicine.

In 1888, Dr. Barnes invented a tin matrix, tin labial clamp and shield; introduced celluloid film strips for polishing amalgam and cement fillings and also for matrices, and called attention to abrasion of the teeth and injuries of the gums caused by improper tooth brushing methods. He also developed several technics for making gold inlays.

Dr. Barnes was a member of the Ohio State, Northern Ohio and national dental organizations and an organizer of the Cleveland Dental Society. He was the president of the state examining board 1902-1907. He was also a member of Delta Sigma Delta and a Mason.

For the last seven years, Dr. Barnes had been associated with his son, Varney E. Barnes, in the practice of preventive dentistry. For the last year and a half, he had been associated also with his grandson, Richard E. Barnes. In addition to Dr. Barnes, his son, he is survived by one daughter, Mrs. Dean C. Ober.



HENRY BARNES
(1851-1932)

COUNCIL ON DENTAL THERAPEUTICS

AMMONIACAL SILVER NITRATE*

By SAMUEL M. GORDON, Ph.D., and EDWIN W. SHAND, Ph.D., Chicago, Ill.

PREPARATION AND STANDARDIZATION

A. Historical Introduction.—Silver compounds have been widely used in the treatment of diseases of the teeth for more than a century. Silver nitrate was used for destruction of dental pulps prior to the introduction of arsenic in 1836. Its efficacy as a prophylactic against dental caries was recognized as early as 1846. The first systematic study of its action in preventing and controlling caries was made in 1902,[1] more than fifty years after its introduction into dental materia medica. Szabo, who treated teeth *in vivo* with solutions of silver nitrate, concluded that the silver nitrate penetrated into the dentinal tubules as silver proteinate, thus checking the progress of caries.

At about the beginning of the present century, it was advocated in the treatment of pyorrhea and infected root canals. About the same time, it was found that treatment was more effective if metallic silver was deposited in the infected area in a fine state of subdivision. Deposition of silver is brought about by a reduction process, either by light or by chemical reductants. Silver nitrate, as is well known, is acted on rather slowly by light and the process is tedious both to the operator and to the patient. If the silver nitrate solution is treated with strong ammonia water until a slight excess of ammonia is present, a solution is obtained (designated as ammoniacal silver nitrate pending further discussion) which is more easily reduced by light and by certain chemical agents, the latter being almost exclusively used today.

It is not in the scope of this report to discuss the theories which have been put forth to explain the action of either the silver proteinate or the finely divided silver. It is generally held that the action is both mechanical and chemical. The inhibiting effects of the silver on the progress of dental decay is held to be due to its "oligodynamic action." This phenomenon, in which metals such as silver, copper and gold in finely divided state exert an inhibitive action on bacteria, has been the source of much investigation, and, as a consequence, there exists an extensive literature on oligodynamy in dentistry.[2]

*From the American Dental Association Bureau of Chemistry.

1. Szabo: Histologische und klinische Untersuchungen über die Wirkungsweise des Argentum Nitricum auf das erkrankte Dentin, Osterreich.-Ungar. Vierteljahrssch. f. Heilk. 18:42, 1902.

2. Turkheim, H.: Ueber die oligodynamische und bakterizide Wirkung einiges Silberlegierungen un Verbindungen, Ztschr. f. Stomatol., 29:1067, 1931 (for partial bibliography). D'Acel, D.: Ueber die oligodynamische Wirkung der Metalle, Biochem. Ztschr., 112:23, 1920.

D'Acel showed by simple methods that metallic silver was germicidal to *B. coli* because of the solubility of silver in distilled water.

According to Prinz,[3] Shanasy was apparently one of the first to use chemical methods for the reduction of silver nitrate. The reducing agent was formaldehyde and potash. Formaldehyde and eugenol are widely used today, but eugenol is used by some in place of formaldehyde because of the marked irritating properties of the latter.

In 1917, Howe[4] reported on the treatment of infected dental pulps with ammoniacal silver nitrate, giving directions for the preparation of the solutions as they are most generally used today. These solutions are (1) "ammoniacal silver nitrate solution" and (2) formaldehyde solution (10 per cent). To our knowledge, a detailed presentation of the chemistry of the preparation of Howe's solution has not appeared; hence, the literature has been reviewed.

Solutions made up according to Howe's recipe were prepared, their properties investigated and standards (for the guidance of the profession and pharmacists) drawn up.

B. The Chemistry of Ammoniacal Silver Nitrate.—When a concentrated solution of silver nitrate is treated with a concentrated aqueous solution of ammonia, the ammonia is rapidly absorbed and a black precipitate is formed. Heat is evolved in the reaction. On further addition of the ammonia, the black precipitate dissolves and a clear solution remains. This is called by dentists "Howe's solution."

The amount of ammonia required to bring about the solution of the black precipitate is close to the amount required by the following equation:

$$AgNO_3 + 2NH_4OH \rightarrow Ag\ (NH_3)_2NO_3 + 2H_2O.$$

There is considerable evidence, direct and indirect, of the existence in solution of the silver diammino nitrate complex as written above.

Much confusion has arisen concerning the proper designation of the compound present in Howe's solution. This solution has sometimes been referred to as ammoniacal silver oxide. The evidence in the literature coupled with our own determinations indicates that this name does not accurately describe the salt in the solution. The designation "ammoniacal silver nitrate" is more in keeping with the evidence. The mistake may be due to the circumstance that Tollens'[5] reagent, which was used in chemical work long before ammoniacal silver solutions were used in dentistry, is prepared from equimolecular quantities of silver nitrate and potassium hydroxide, and sufficient concentrated ammonia water to dissolve the silver oxide. Evidence is lacking as to the salts present in this mixture, but it has been called ammoniacal silver oxide about as often as ammoniacal silver nitrate. Ammoniacal silver oxide, or hydroxide, is prepared by dissolving freshly precipitated and washed silver oxide in concentrated ammonia water.

Both Tollens' reagent and the ammoniacal silver oxide solutions are more readily reducible than ammoniacal silver nitrate. There is also a great difference in the

3. Prinz, Hermann: Dental Materia Medica and Therapeutics, St. Louis: The C. V. Mosby Company, 1926, Ed. 6, p. 233.

4. Howe, P. R.: a Method of Sterilizing and at Same Time Impregnating with Metal Affected Dentinal Tissue, D. Cosmos, 58:891 (Sept.) 1917.

5. Tollens, B.: Ueber Ammono-alkalische Silberlösung als Reagens auf Aldehyd, Ber. d. deutsch. Chem. Gesellsch., 15:1635, 1882.

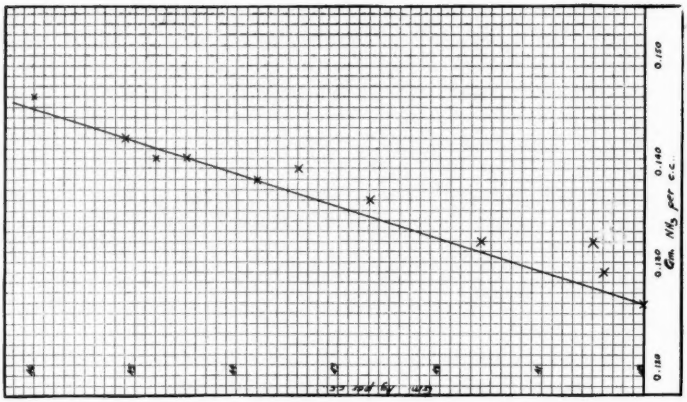


Fig. 2.—Relation of Ag and NH_3 content.

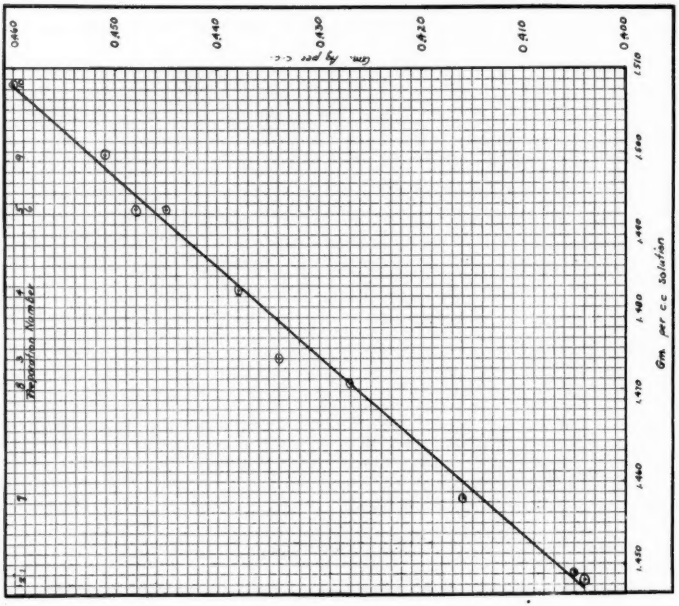


Fig. 1.—Relation of Ag content and density of solution.

explosiveness of the residue left on evaporation. Tollens' reagent and ammoniacal silver oxide are known to yield explosive residues.[6] The chemical literature makes no specific mention of the explosiveness of residues from ammoniacal silver nitrate solutions. The residues from solutions as prepared according to Howe's directions were found not to be explosive when tested in a manner subsequently described.

The following facts furnish evidence of the existence of silver diammino nitrate ($Ag\ [NH_3]_2NO_3$) in solution and point to the mechanism of its formation:

A. B. Prescott[7] showed that approximately two molecules of ammonia are required for the solution of one molecule of silver nitrate. Without a previous knowledge of this work, a similar experiment was made by us, using the concentrations as given in Howe's directions, with essentially the same result. Prescott expressed the products of the reaction as silver ammonium oxide, and ammonium nitrate. This has been shown to be incorrect.

Mitscherlich[8] found that a solution of silver nitrate saturated with ammonia gas yielded crystals of an ammonia salt corresponding to $Ag(NH_3)_2NO_3$. We were able to show the same composition for a crystalline salt isolated from a solution prepared according to Howe's directions.[4]

Konowaloff,[9] from vapor pressure measurements, and Reychler,[10] from freezing point data, showed that no change occurred in the freezing point lowering or in the vapor pressure of silver nitrate solutions with additions of ammonia until 2 molecules of ammonia per molecule of silver nitrate had been added.

H. N. Draper[11] obtained silver ammino nitrate, the same compound as Mitscherlich had obtained, by dissolving silver oxide in ammonium nitrate. This gives a clue to the mechanism for the formation from silver nitrate and the process may be written as follows:

$$
\begin{array}{rcrcrcl}
 & & 2AgNO_3 & + & 2NH_4OH & \longrightarrow & [2AgOH] + [2NH_4NO_3] \\
 & & & & [2AgOH] & \longrightarrow & [Ag_2O] + H_2O \\
[Ag_2O] & + & [2NH_4NO_3] & + & 2NH_4OH & \longrightarrow & 2Ag(NH_3)_2NO_3 + 3H_2O \\
\hline
 & & 2AgNO_3 & + & 4NH_4OH & \longrightarrow & 2Ag(NH_3)_2NO_3 + 4H_2O
\end{array}
$$

This mechanism depicts the formation and solution of silver oxide to form silver ammino nitrate (ammoniacal silver nitrate).

Electromotive force measurements indicate that dissociation (ionization) of the salt, silver diammino nitrate into silver diammino and nitrate ions, is practically complete when the salt is dissolved in water.[12] The further dissociation of the silver

6. Sieverts, A.: Ueber die Gefahr der Knallsilberbildung, Ztschr. Angewandte Chem., 22:6, 1909.

7. Prescott, A. B.: Silver Ammonium Oxide in Solution, Chem. News, 42:31, 1880.

8. Mitscherlich, G. C.: Saltpetersaueres Silberoxyd-Ammoniak, Poggendorf's Ann., 9:413, 1827.

9. Konowaloff, D.: Ueber die Löslichkeit des Ammoniaks in wässerigem Lösungen von Silbernitrat, J. Russ. Phys. Chem. Soc., 30:367, 1898, in Chem. Centralbl., 69:659, 1898.

10. Reychler, A.: Zur. Constitution der Silberammoniakverbindungen, Ber. d. deutsch Chem. Gesellsch., 28:555 (1895).

11. Draper, H. N.: Ammonio-Nitrate of Silver, Pharm. J., 17:487, 1886.

12. Bodländer & Fittig: Das Verhalten von Molekulaverbindugen bei der Auflösung-II, Ztschr. Phys. Chem., 39:597, 1901.

ammino complex ion into silver ion and ammonia is small, the dissociation constant (K) being of the order of 1×10^{-8}.[13]

When a current of air (CO_2 free) is drawn through a dilute solution of ammoniacal silver nitrate, a small amount of ammonia is aspirated, even when the solution contains a slight excess of silver ion. This indicates the dissociation of the complex. At the same time, a slight amount of yellowish precipitate forms in the solution which appears to be silver oxide.

The addition of strong acids brings about decomposition of the complex with the formation of silver and ammonium salts.

$$\begin{aligned} Ag(NH_3)_2^+ &+ 2H^+ \longrightarrow Ag^+ + 2NH_4^+ \\ Ag(NH_3)_2NO_3 &+ 2HNO_3 \longrightarrow AgNO_3 + 2NH_4NO_3 \\ Ag(NH_3)_2NO_3 &+ 2HCl \longrightarrow AgCl + NH_4NO_3 + NH_4Cl \end{aligned}$$

The silver thus is liberated in a form which permits its ready quantitative determination.

The addition of salts of the halogens produces insoluble silver halides (AgCl, AgBr, AgI), with the liberation of ammonia. Advantage of this reaction is taken by dentists as an antidotal measure or in the removal of excess solution applied locally.

$$Ag(NH_3)_2NO_3 + NaCl \longrightarrow AgCl + NaNO_3 + 2NH_3$$

The addition of soluble sulphides produces insoluble silver sulphide with the liberation of ammonia.

$$2Ag(NH_3)_2NO_3 + Na_2S \longrightarrow Ag_2S + 2NaNO_3 + 4NH_3$$

The subsequent addition of strong alkalis and heating causes the ammonia to be expelled while the sulphide is changed to silver oxide.

$$Ag_2S + 2KOH \longrightarrow Ag_2O + K_2S + H_2O$$

A knowledge of these reactions was essential to the application of methods of analysis to ammoniacal silver solutions.

A large number of substances act to reduce ammoniacal silver nitrate, probably through the intermediate formation of silver hydroxide.

$$2AgOH + HC\begin{matrix} \diagup\!\!\diagup O \\ \diagdown H \end{matrix} \longrightarrow 2Ag + HCOOH + H_2O$$

Formaldehyde — Formic acid

This reaction will be noted as the type reaction for the oxidation by silver as practiced in organic chemistry.

The silver compound reacts with aldehydes, polyhydroxybenzenes, aminophenols, hydrazines and inorganic substances as hydrazine, hydrogen peroxide and most of the common metals.

Only two substances, formaldehyde and eugenol, have come into practical use as reductants in dentistry. In view of the large number of compounds which will reduce the silver, it is not improbable that some might be found that are more efficient than those in use. Formaldehyde under certain conditions produces undesirable irritation. Hydrazine and hydrogen peroxide yield gaseous products; hence, the reagents may be found to be of service.

13. Von Euler: Ueber Complexe Silberionen, Ueber Silberammoniak basen und Silbercyanwasserstoffsaüre, Ber. d. deutsch. Chem. Gesellsch., 36:1854, 2878, 1903.

$$4Ag^{+} + NH_2{-}NH_2 \longrightarrow 4Ag + N_2 + 4H^{+}$$
$$2Ag^{+} + H_2O_2 \longrightarrow 2Ag + H_2O + O^{=}$$

C. Experimental Data.—1. Preparation and analysis. In order to formulate standards for Howe's ammoniacal silver nitrate solutions, a number of these solutions were prepared according to Howe's directions[4] and analyzed. U.S.P. chemicals and distilled water were used in the preparation. Howe's directions require the treatment of the saturated solution of silver nitrate with strong ammonia water until the primary precipitate just dissolves. Howe did not specify the temperature of saturation until recently.[14] In order to determine the effect of variations in temperature, saturated solutions were prepared at intervals of 5 degrees from 15 to 30 C. and the ammoniacal silver nitrate solutions obtained were analyzed. The saturated silver nitrate solutions and the strong ammonia water were analyzed by U.S.P. methods.

An accurately measured volume of the silver nitrate solution was transferred to a glass stoppered bottle and strong ammonia water added drop by drop from a buret until the black precipitate which formed just dissolved. In every case, a slight black shiny residue remained which was insoluble in water, but soluble in diluted nitric acid. It appears to be silver formed from impurities with reducing properties in the ammonia water. If the solutions are allowed to cool considerably below room temperature, crystallization of the silver ammino nitrate may take place. Several of the prepared solutions were observed to have deposited crystals on standing overnight in a cold room in which the temperature had fallen below 15 C. The salt was redissolved by slight warming.

The resulting solutions were analyzed for silver, ammonia and aspirable ammonia and the weight of 1 c.c. determined. The silver content was determined by acidifying the solution to be analyzed with dilute nitric acid and titrating with standard potassium thiocyanate solution, using ferric alum indicator.[15] The results obtained by precipitation of the silver as silver chloride with a slight excess of hydrochloric acid were in agreement with those obtained by the U.S.P. method.

The ammonia content was first determined by distilling the filtrate remaining after precipitation of the silver chloride with excess magnesium oxide, collecting the ammonia in standard acid and titrating the excess acid with standard base and methyl red as indicator. This was later found to be a tedious and unnecessarily complex procedure. A better procedure was to transfer the sample directly to a Kjeldahl flask and to dilute with water. An excess of sodium sulphide and sodium hydroxide solution was added and the distillation and titration completed as before. The method is rapid and yields good results.

The amount of "aspirable" ammonia was determined by aspirating a diluted solution with air, previously passed through soda lime, dilute hydrochloric acid and water. The aspirate was collected in standard hydrochloric acid and the excess acid titrated with standard alkali and methyl red indicator. The method does not indicate small differences in free ammonia content since decomposition occurs in the solution during aspiration, but it shows large excesses of free ammonia.

14. Howe, P. R.: Personal communication regarding method used in Forsyth Dental Infirmary.

15. U.S.P.X, p. 62.

	Preparation							Finished Solutions								
Prep. No.	$AgNO_3$ Used* C.c.	Temperature (C.) of Saturation	Grams $AgNO_3$ per C.c.	Grams Ag per C.c.	NH_3 Used Per Cent	Strong NH_3 Water Required C.c.	Temperature (C.) Analysis	Weight of 1 C.c. Sol. Grams†	Ag per C.c. Grams	Ag Per Cent‡	NH_3 Per C.c. Grams	NH_3(4) PerCent#	$\frac{Ag}{2NH_3} = \frac{108}{34}$ Required	Gm. Ag /C.c. / Gm. NH_3/C.c. Found	Grams Aspirable NH_3 per C.c.	"Aspirable" NH_3 Per Cent¶
1	5	22.0	1.56	0.991	25.5	7.22	21	1.449	0.405	28.0	0.132	9.11	3.18	3.07	0.0005	0.04
2	5	22.0	1.51	0.959	25.1	7.05	21.5	1.448	0.404	27.9	0.129	8.91	3.18	3.15	0.0005	0.04
3	5	21.5	1.56	0.991	28.5	6.35	21.5	1.475	0.434	29.4	0.139	9.42	3.18	3.12	0.003	0.21
4	5	21.5	1.56	0.991	28.5	6.25	21.5	1.483	0.438	29.6	0.138	9.31	3.18	3.17	0.002	0.11
5	10	24.5	1.59	1.010	28.5	12.70	22.5	1.493	0.445	29.8	0.140	9.38	3.18	3.18	0.002	0.14
6	10	24.5	1.59	1.010	28.5	13.00	22.5	1.493	0.448	30.0	0.140	9.38	3.18	3.20	0.001	0.09
7	5	15.0	1.42	0.900	28.5	5.73	20	1.458	0.416	28.5	0.132	9.06	3.18	3.16	0.001	0.09
8	5	20.0	1.48	0.938	28.5	6.01	20	1.472	0.427	29.0	0.136	9.24	3.18	3.15	0.002	0.12
9	5	25.0	1.65	1.050	28.5	6.72	20	1.498	0.451	30.1	0.142	9.48	3.18	3.18	0.002	0.10
10	5	30.0	1.75	1.110	28.5	7.10	20	1.508	0.460	30.5	0.146	9.68	3.18	3.15	0.002	0.10

*Saturated solution. †Temperature same as that of analysis. ‡Grams per hundred grams. #Grams per hundred grams.
¶Grams per hundred grams.

For example, 1 c.c. of preparation number 2, when diluted to 20 c.c. and aspirated, yielded 0.0005 gm. of ammonia (NH_3). Another cubic centimeter of the same preparation, to which 2 drops (approximately 0.05 c.c.) of strong ammonia water had been added, yielded 0.003 gm. of ammonia.

The accompanying table gives the results obtained.

2. Results. Preparations 1 and 2 are not to be regarded as standard preparations since ammonia water was employed which was slightly below the standards of the U. S. Pharmacopeia. However, they serve to point out the necessity of using the U.S.P. strong ammonia water to obtain compliance with the standards proposed later on.

Preparations 3, 4, 5, 6 were made from silver nitrate solutions saturated at ordinary room temperatures by manual shaking and U.S.P. ammonia water. The variations in silver and ammonia content of the finished products are slight. These show that preparations which are closely in accord with the standards reported further on can be made by a careful worker.

Preparations 7, 8, 9 and 10 were made under still more carefully controlled conditions. The silver nitrate solution was prepared by vigorous stirring of an approximately saturated solution in contact with excess solid silver nitrate in a thermostat at constant temperature (+0.05 C.) for one hour. The results obtained by analysis of the saturated solution of silver nitrate and of the finished preparations show the effect of temperature on the silver and ammonia content. The range covers all temperatures likely to be encountered in practical work.

The ratio of silver to ammonia necessary to form the compound $Ag(NH_3)_2NO_3$ $\frac{Ag}{2NH_3}$ is 3.18. The experimental ratios $\frac{\text{Gm. Ag/c.c.}}{\text{Gm. } NH_3\text{/c.c.}}$ found indicate the nature of the compound formed as well as the fact that the solution contains an excess of neither silver or ammonia. The ratio does not indicate the strength of the solution, but only that the correct amount of ammonia to correspond with the silver present has been added. The ratio is independent of the concentration of the silver nitrate or the ammonia used. A knowledge of the silver content is essential in defining the preparation.

It has been mentioned that the "aspirable" ammonia is not a critical figure in well-made solutions. It may be used as an added criterion of a well-made solution, but a knowledge of the silver content and ammonia content will be adequate to the purpose.

3. Properties of Howe's ammoniacal silver nitrate. (*a*) Reducibility: Reference has been made to the easier reducibility of ammoniacal silver nitrate over silver nitrate. A few simple tests bear this out. The prepared solution of ammoniacal silver nitrate was compared with a saturated silver nitrate solution and an ammoniacal silver oxide solution, prepared as described by Rickert[16] using 10 per cent formaldehye as the reducing agent. Three drops of each solution were placed on a white porcelain test plate and one drop of formaldehyde solution added. The time required for the production of the first noticeable black precipitate was

16. Rickert, U. G.: Advantages and Disadvantages of Reduced Silver in Dental Therapeutics, J. N. D. A., 6:930 (Oct.) 1919.

observed to be as follows: ammoniacal silver oxide, instantaneous; ammoniacal silver nitrate, within a few seconds; silver nitrate, five minutes.

Tests were made to determine the effect of reducing agents other than formaldehyde and eugenol. With those reagents which were at hand, and expected to reduce ammoniacal silver nitrate, the following results were obtained: (1) very rapid reduction: chloral hydrate, guaiacol, tannic, gallic and pyrogallic acids, phenyl hydrazine and hydrogen peroxide (the last two with evolution of gas); (2) moderately rapid reduction: cresol, resorcinol, hexylresorcinol, formic acid (white precipitate first). The tests were made by applying the above-mentioned substances undiluted on the end of a glass rod to the ammoniacal silver nitrate solutions on a white porcelain test plate. The value of any of the reducing agents mentioned in actual practice depends on therapeutic considerations which are beyond the scope of this report.

(*b*) Composition of solution: Reference has already been made to the work of others which pointed to the circumstance that Howe's solution represents a solution of silver diammino nitrate.

The existence of silver diammino nitrate in solution was confirmed by analysis of the crystals obtained from Howe's solution, which agreed with the theoretical percentage amounts of silver and ammonia for $Ag(NH_3)_2NO_3$.

The compound was isolated in solid form and analyzed.

Approximately 10 c.c. of preparation No. 6 was placed in a wide mouth bottle in a thermostat at 6.5 C. for thirty minutes. Long white prisms separated. These were filtered quickly and pressed between filter papers to remove as much adhering liquid as possible. The odor of ammonia was not apparent. They were then placed in a weighing bottle, weighed and dissolved in water to a volume of solution of exactly 50 c.c. Ten cubic centimeter portions were analyzed for silver and ammonia by the same method as for the original solutions. A portion of the moist crystals was allowed to air dry on filter paper for one-half hour and analyzed. The results were as follows:

PREPARATION NO. 6

	Gm. Ag/Gm.	Gm. NH_3/Gm.	Ratio Ag/NH_3
Crystals (moist)	0.509	0.157	3.24
Crystals (dried thirty minutes)	0.527	0.162	3.25
Theoretical for $Ag(NH_3)_2NO_3$	0.529	0.167	3.18
Theoretical for $Ag(NH_3)_2OH$	0.679	0.214	3.18
Theoretical for $AgNO_3 \cdot 2NH_4NO_3$	0.327	0.103	3.18

Preparation No. 5 was treated in a similar manner except that the solution was cooled to 8 C. and the crystals were analyzed only after drying.

PREPARATION NO. 5

	Gm. Ag/Gm.	Gm. NH_3/Gm.	Ratio Ag/NH_3
Crystals (dried thirty minutes)	0.527	0.161	3.27
Theoretical for $Ag(NH_3)_2NO_3$	0.529	0.167	3.18

The compound melted with decomposition at about 140 C. with deposition of a silver mirror. Mellor[17] (Vol. 3, p. 478) reports 170 C.

17. Mellor, J. W.: Inorganic & Theoretical Chemistry, London: Longmans, Green & Co., 1928.

From the foregoing, it appears that the name ammoniacal silver nitrate is the correct chemical designation for the solution.

(*c*) Explosiveness: There are many reports[6] in the literature on the explosibility of ammoniacal silver compounds. When these were reviewed, it was found that the explosive preparations were either residues from Tollens' reagent (ammoniacal silver nitrate plus caustic potash) or ammoniacal silver oxide solutions. Draper[11] pointed out the great difference between ammoniacal silver nitrate solution and the two ammoniacal silver solutions which were found to yield explosive products; namely, ammoniacal silver oxide solution and ammoniacal silver solutions containing alkali bases.

In this work, a number of ammoniacal silver nitrate solutions have been kept on hand for several months, and black residues from these have been observed. When these residues were subjected to heat and friction, no explosion occurred. On the basis of these observations, and on the experience of the authors cited, it is probable that there is little if any danger from explosion with well-prepared ammoniacal silver nitrate solutions.

D. Standards.—On the basis in part of the chemical examination reported herein and available information, the following standards are proposed:

Ammoniacal Silver Nitrate (Howe): A solution containing approximately 30 per cent silver as silver diammino nitrate; solution of silver diammino nitrate, approximately 57 per cent. $Ag(NH_3)_2NO_3$.

Ammoniacal silver nitrate (Howe) is a clear, colorless solution prepared by the careful addition of strong ammonia water U.S.P. to a saturated solution of silver nitrate U.S.P., until all but the last trace of black precipitate is dissolved. The saturated silver nitrate solution should be prepared at ordinary temperatures (15 to 30 C.). It should contain not less than 28.0 per cent nor more than 32.0 per cent silver (Ag) and not less than 8.9 per cent nor more than 9.8 per cent ammonia (NH_3). The ratio $\frac{\%Ag}{\%NH_3}$ should not be less than 3.10 nor greater than 3.60. It should be marketed in all glass containers. The weight of 1 c.c. at 20 C. is between 1.45 and 1.55 gm.

The solution is strongly alkaline to litmus. It yields an immediate black precipitate with 10 per cent formaldehyde solution (distinction from solution of silver and ammonium nitrate). A diluted solution (1 in 10) responds to the tests for silver and nitrate, U.S.P.X. Five cubic centimeters of a diluted solution (1 in 10) is treated with 2 c.c. of diluted hydrochloric acid, filtered and made alkaline with 5 c.c. sodium hydroxide solution, and boiled. The vapors turn red litmus blue (ammonia).

The solution is colorless, exhibiting not even the faintest blue (copper).

To 1 c.c. of ammoniacal silver nitrate, add 3 c.c. of diluted hydrochloric acid, and filter. The clear solution, when tested in a flame test with a platinum wire, yields no more than the usual traces of alkali (sodium or potassium) (distinction from Tollens' reagent).

Accurately pipet 1 c.c. to a weighing bottle and determine the weight of the sample. Transfer the contents to an Erlenmyer flask with 50 c.c. of distilled water, adding 10 c.c. of diluted nitric acid and 5 c.c. of ferric alum solution. Titrate

with tenth normal potassium thiocyanate solution. The amount of silver found is not less than 28.0 per cent nor more than 32.0 per cent.

Accurately pipet 1 c.c. to a Kjeldahl distilling flask, and dilute with distilled water to a volume of 200 c.c. Add 10 c.c. of sodium sulphide solution (10 gm. $Na_2S.9H_2O$ per hundred cubic centimeters) and 20 c.c. sodium hydroxide solution (40 gm. NaOH per hundred cubic centimeters). Connect the flask to a condenser and distil approximately 100 c.c., collecting the distillate in 50 c.c. of half normal hydrochloric acid. Titrate the excess acid with half normal sodium hydroxide, using methyl red as indicator. The percentage of ammonia (NH_3) obtained divided by the percentage of silver obtained is not less than 3.10 nor greater than 3.60. The amount of ammonia found is not less than 8.9 per cent nor more than 9.8 per cent.

Accurately pipet 1 c.c. to an aspirating apparatus.[18] Add 20 c.c. of distilled water. Aspirate for one hour at a lively rate, collecting the aspirated gases in 25 c.c. of fiftieth normal hydrochloric acid. The air used for aspiration is drawn through a soda lime tube, then through fiftieth normal hydrochloric acid and through water to remove traces of carbon dioxide and ammonia in the air. Titrate the excess acid with fiftieth normal sodium hydroxide solution using methyl red as the indicator. Not more than 5 c.c. of fiftieth normal hydrochloric acid is required for neutralizing the "aspirable" ammonia.

18. Van Slyke, D. D., and Cullen, J.: Apparatus for Determining Urea Content, J. Biol. Chem., 19:217, 1914; Hawk, P. B.: Practical Physiological Chemistry, Ed. 7., Philadelphia: P. Blakiston & Son, 1921, p. 515.

BUREAU OF PUBLIC RELATIONS

THE DENTAL SECTION OF THE CARLETON COLLEGE* HEALTH SERVICE

By WILLIAM A. GREY, D.D.S., St. Paul, Minn.

AFTER a thorough consideration of dental health service throughout the country, and with a realization of the need for such a service at Carleton College, Dr. Donald J. Cowling, president of the college, sought my help in the organization of a dental division in connection with the Carleton College Health Service, in consideration of the fact that I had been in charge of the dental service in Elliot Memorial Hospital, University of Minnesota, for fourteen years.

A meeting was called with the seven resident dentists of Northfield, at which all arrangements were made to proceed with this work. It was decided that Miss Dorothy Arny, B.S., University of Minnesota, and also a graduate of the dietetics course at Peter Bent Brigham Hospital, Boston, would be secured as a full-time assistant. Oral diagnoses of student cases were to be made three evenings each week, and the Northfield dentists each agreed to spend at least one evening a week roentgenographing and examining the mouths of students. It was also agreed at the time of organization that only diagnostic work would be done, and that no changes would be made in the department without the unanimous consent of the Northfield dentists. Regular meetings were to be held by the group in order to discuss the policies of the service.

Actual work in the dental service began about Jan. 1, 1931. Great care was taken that the equipment purchased should be complete in every detail necessary for the type of service to be rendered. It includes a Ritter x-ray machine, an electrically operated chair, a sterilizer, an x-ray viewing box, a Cameron transilluminator, an instrument cabinet and instruments, suitable lighting fixtures and a filing cabinet for records. The examination room itself, with its large windows and light green walls, is an attractive place in which to work. A dark room is equipped for the development of roentgen-ray films and plates. This equipment has been found to be adequate for the oral examination of the students of Carleton College (enrollment 800-900).

Under the plan carried out for the period Jan. 1 to June 1, 1931, each senior student was given a complete oral examination, both clinical and roentgenographic. By unanimous vote of the Northfield dentists, any other student or member of the faculty and administration group was entitled to a similar examination for a moderate fee. The routine examination included the following steps: (1) a clinical examination in which the general mouth condition, especially the condition of the soft tissues, the teeth missing, and the presence of cavities, restoration, arch deformities, etc., were noted; (2) a full mouth roentgen-ray examination (fourteen roentgenograms), which, in many cases, showed some or all of the following: additional cavities, impacted teeth, rarefied areas, defective

*Northfield, Minn.

bridges, crowns, etc. The x-ray mounts (Fig. 1), which were made especially for this work, have space for the separate recording of the results of each of the two examinations, clinical and roentgenographic. Since there were at least two dentists working together each time, one man checked the diagnosis made by the other.

After the examination, the student was advised to see his dentist in order to have the necessary services rendered, and to return to the dental service for a re-examination. The objects of this are: (1) to determine just what interest the student took in the work, from an educational and health standpoint; (2) to see what type of work is being done in students' mouths, and (3) to stimulate the dentist performing the service to do his best. In the opinion of the dental service, there are two measures which will prevent the introduction of panel dentistry into this country: the education of the general public, and the promotion of efficient workmanship by the dental profession as a whole, at a fee which is within the means of the average person.

The diagnosis sent with the roentgenograms to the student's dentist is in accordance with the best judgment of those who made the examination, taking into consideration not only the condition of the student's mouth, but also his general physical condition, as observed by the medical health service. If, for financial reasons, it was impossible for a student to have his mouth put in good condition, the dental service extended every effort to cooperate with the student's dentist in order to make the necessary service possible.

The total number of senior students examined during the first five months, from Jan. 1 to June 1, 1931, was 147. A record of each examination, as well as copies of all roentgenograms, were kept in the files of the dental service. At the end of the year, a statistical report was made from the records in order to show the results of the year's work in terms of conditions found. Following is a brief statement of these findings:

CLINICAL FINDINGS

Seventy, or about one-half of the students, needed prophylaxis and a large proportion showed lack of proper home care of the mouth. The total number of cavities found was 745; average number of cavities per student, five; total number of missing teeth, 436, and total number of extractions recommended, twenty-one.

ROENTGENOGRAPHIC FINDINGS

In addition to the clinical findings the following were revealed roentgenographically: cavities, 221; infected areas, 18; devitalized teeth, 43; unerupted teeth, 109; impacted teeth, 101; questionable teeth, 17; defective restorations, 118; and extractions recommended, 134.

The first year's work had three objectives: the welfare of the students; the determination of the value of roentgenograms in oral diagnoses, and the establishment of as nearly an ideal dental health service as possible. Since each roentgenographic examination was made after the clinical examination was complete, and note made only of conditions not found clinically, we feel that all cavities, impacted teeth, rarefied areas, defective restorations, etc., listed in the roentgenographic findings, would not have been found without the aid of the roentgenogram.

The following Northfield dentists and I gave our time and interest to the Carleton Dental Service during the period Jan. 1 to June 1, 1931: L. Amodt, E. O. Erickson, H. H. Godberson, F. A.

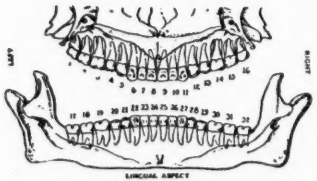
ORAL DIAGNOSIS By

Name..... Age.....

Address.....

Date..... Year..... No.....

CARLETON COLLEGE HEALTH SERVICE



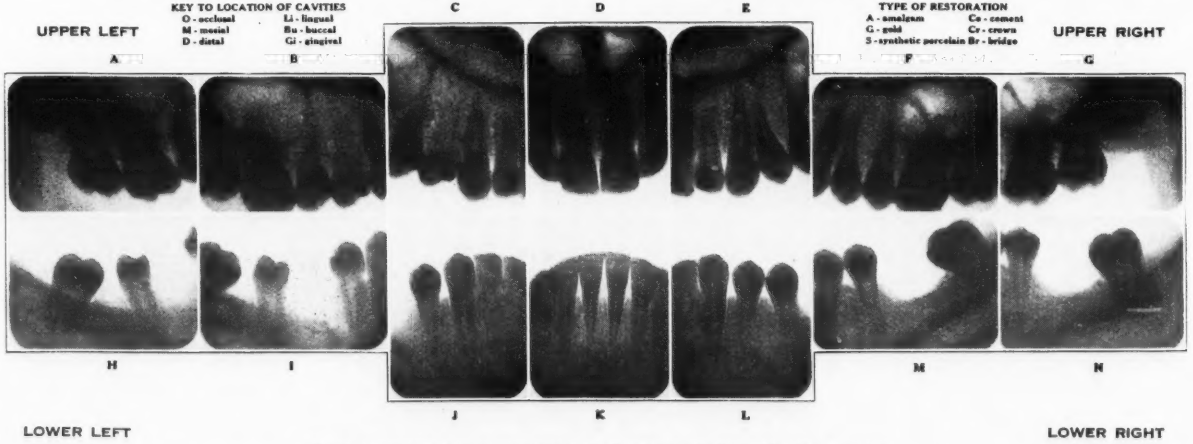
We reserve the right to Reray the mouth at any time during College Course.

	Gum Condition	Home Care								Prophylaxis																			
		UPPER LEFT								UPPER RIGHT								LOWER LEFT								LOWER RIGHT			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
CLINICAL	Missing Teeth																																
	Cavities																																
	Type of Restoration																																
	Defective Contacts																																
	Vitality																																
RADIOGRAPHIC	Cavities																																
	Pulpless Teeth																																
	Apical Areas																																
	Unerupted Teeth																																
	Impactions																																
	Questionable Teeth																																
	Questionable Restorations																																
	Roots																																
	Extractions Recommended																																
	Alveolar Process																																

NOTICE - Full mouth X-Rays are required of every student each year as part of physical examination. We suggest that the dentist in charge re-check this mouth and use his discretion concerning the above diagnosis.

KEY TO LOCATION OF CAVITIES
O - occlusal Li - lingual
M - mesial Bu - buccal
D - distal Gi - gingival

TYPE OF RESTORATION
A - amalgam Ce - cement
G - gold Cr - crown
S - synthetic porcelain Br - bridge



DENTAL FILM MOUNT CO. 2604 NICOLLET AVE. MINNEAPOLIS, MINN.

Oral diagnosis chart employed in Carleton College Health Service.

Heiberg, R. D. Kelsey, C. W. Lee and H. C. Remele.

It was very evident that the work was a stimulus, not only to each of these men, but also to dentistry in general, and an opportunity for the development of a broader knowledge along the lines of diagnosis, which is acknowledged by all to be the foundation of the profession.

Another phase of the function of the dental service was the educational program carried out throughout the college year for both students and faculty. I gave one illustrated lecture to the faculty, two to the senior class, and one to a large class in preventive medicine. Charles H. Mayo, of Rochester, Minn., lectured to the entire student body on the influence of the condition of the mouth on the general health and well-being. A demonstration of the proper home care of the mouth was given to a group of students. A number of lantern slides for demonstration purposes were made from the roentgenograms of some of the most interesting cases examined.

In consideration of the value of the work of the Carleton Dental Health Service during the period up to June 1, 1931, both as it directly affected the welfare of the students, and as a research problem, it was decided that, beginning Oct. 1, 1931, this service would be established as a permanent division of the Carleton Health Service. Therefore, from that time on, each student would receive a thorough oral examination each year. Special lecture hours were planned, so that all students would be given three lectures during the year as follows: (1) on the development of the teeth and the importance of retaining them in the arch in a healthy condition; (2) on the importance of thorough everyday home care of the mouth and a demonstration of an efficient method, and (3) on the diseased conditions of the teeth and surrounding soft tissues as they relate to the health of the student.

Because of the added work which was planned for the year 1931-1932 in examining the mouths of the entire student body, William Branstad, graduate of the College of Dentistry, University of Minnesota, 1930, was secured as full-time assistant for the college year. Before starting the work in October, 1931, I met with the Northfield dentists, and detailed plans for the year were discussed. It was decided (1) that the dental service would be open and ready to serve students any time during the college week; (2) that the Northfield dentists would give time during the day, rather than in the evening, and (3) that the diagnostic work would be carried on as in the previous year.

Up to December, 1931, 400 students had been called into the dental service and given a thorough oral examination. As each examination was completed, the student was advised that before seeing his dentist, he should call at the dental service for his roentgenograms and diagnosis, take them to his dentist and see that they were returned to the service after the work was finished. Of the 400 students examined before the Christmas holidays, 287 called for their roentgenograms. After the vacation, college was again in session on January 5, and from that time until spring vacation, 200 more students were examined. Of this number, 183 took their roentgenograms to their dentists. From April 1 to June 1, about 200 more students were examined and, before leaving for summer vacation, 166 of these called for their roentgenograms. These figures are significant in that they indicate the interest that the students have taken in the dental service as it relates to their welfare.

During my many years of service at Elliot Memorial Hospital, in close association with both medicine and dentistry, the value of the roentgenogram was impressed on me until, during the last few years spent there, full mouth roentgenograms were taken of practically every patient receiving service in the dental section. The value of the full mouth examination from the standpoint of both the medical and dental departments could not be overestimated. This experience, along with the splendid work done by Boyd S. Gardner, who is in charge of the Mayo Clinic Dental Service at Rochester, Minn., has thoroughly convinced us that the full-mouth roentgen-ray examination is one of the essential and the most economical factors in a thorough diagnosis, not alone with hospital patients, but with young persons of college age as well. It is our opinion that the conditions which we have found at Carleton indicate the necessity of establishing this work in other colleges and universities. We feel that if this type of service were provided for young persons of high school age many of the extreme conditions which we have found might have been prevented.

We have attempted to make this entire report as clear, simple and practical as possible. The data have been compiled after carefully recording of the findings of a thorough examination of each student.

Some time after this work was started, it was brought to our attention by men prominent in the profession that, in their opinion, practically all students who attend a college of the type of Carleton would have had full mouth roentgenograms of the mouths before leaving home in the fall. Consequently, as we are looking for facts along these lines, we felt that Carleton College would afford an excellent cross-section, and that data compiled could be considered as typical of what would be found in the mouths of students in colleges throughout the country. We therefore questioned 452 students and have found that of this number, 55, or only 12 per cent, had had complete sets of roentgenograms taken previously; 85, or 19 per cent, had had one or two, and 312, or 69 per cent, had had none at all. From this time on, this information will be secured from each student examined. We are looking forward to seeing just what the results in 1,000 cases will be. We are attempting to base all of our findings on 1,000 cases, but it is our opinion at this time that the ratio will remain about the same.

TABLE 1.—A COMPARISON OF THE INCIDENCE OF DECAY IN THE UPPER AND LOWER JAWS OF THREE HUNDRED SEVENTY-EIGHT CARLETON STUDENTS

Total number of surfaces restored	4,971
Total number of new cavities	1,890
Total number of defective surfaces	6,861
Defective in the upper jaw (restored surfaces plus new cavities)	3,877
Defective surfaces in the lower jaw (restored surfaces plus new cavities)	2,984
Percentage of defective surfaces in the upper jaw	57 (of total)
Percentage of defective surfaces in the lower jaw	43 (of total)
Percentage of defective surfaces in upper jaw over those in lower jaw	30
Average number of defective surfaces per student	18

Many interesting problems have been brought up since this work was started. In January, 1932, while attending the Chicago meetings, Dr. Blayney of the Illinois Dental College suggested that we had an excellent opportunity to determine the amount of decay in the upper as compared with the lower teeth. Therefore, it was decided among our group of dentists that records would be kept

TABLE 2.—CAVITIES FOUND IN EXAMINATION OF SEVEN HUNDRED EIGHTY STUDENTS

		Occlusal	Mesial		Distal		Buccal	Gingival	Lingual
			Clinically	Roentgenographically	Clinically	Roentgenographically			
Upper Left									
Tooth	1	101	2	1	4	0	9	0	4
	2	214	20	12	16	5	25	0	20
	3	86	52	32	50	43	3	2	27
	4	18	45	16	52	25	2	0	1
	5	31	18	6	44	24	4	2	0
	6	0	16	7	24	9	2	3	6
	7	0	30	11	27	15	3	1	16
	8	0	24	16	26	8	0	0	1
Upper Right									
Tooth	9	0	31	15	40	9	2	1	2
	10	0	30	13	22	15	2	0	12
	11	0	14	7	10	9	3	2	3
	12	25	21	8	39	15	2	1	0
	13	19	42	14	47	25	0	1	0
	14	86	75	24	30	38	2	1	28
	15	173	33	22	13	1	19	1	24
	16	81	3	1	0	0	7	0	1
Lower Left									
Tooth	17	89	11	4	1	0	10	0	1
	18	167	23	24	15	10	37	4	4
	19	62	22	14	49	59	60	2	5
	20	42	15	10	51	44	5	2	0
	21	15	6	7	21	14	5	3	1
	22	0	1	2	27	3	4	5	0
	23	0	3	4	6	5	2	0	0
	24	0	9	1	9	7	0	0	0
Lower Right			6	4	10	1	2	0	0
Tooth	25	0	9	5	4	11	1	0	0
	26	0	2	4	5	3	1	2	0
	27	0	2	6	21	22	5	0	0
	28	9	23	23	41	49	5	2	0
	29	31							
	30	58	28	25	44	59	50	5	2
	31	154	21	37	11	9	46	4	4
	32	51	2	1	1	0	12	1	0
Total		1,512	642	376	740	545	330	45	162
Total		4,352							

Total number of cavities found, 4,352.
Average number of cavities per student, 5.

on this point. The findings which we have obtained are the results of careful clinical and roentgenographic diagnoses.

The total number of defective surfaces was obtained from the number of surfaces that had been restored plus the new cavities that had occurred. (Table 1.)

The cavities alone found in the cases examined thus far would warrant many times over the time and expense put into the work. (Table 2.)

Another interesting problem which we

have been observing is the number of missing teeth noted, both clinically and roentgenographically. The object of this step of the work has been to bring to the attention of the profession the number of teeth extracted for young persons of college age, and how often this might have been prevented by closer observation and more extensive use of roentgenograms by the dentist, and by educating young people as to the importance of saving many of these teeth, in the interests of health, mastication and economy.

TABLE 3.—MISSING TEETH IN SEVEN HUNDRED AND EIGHTY MOUTHS

Upper		Lower	
1	507	17	497
2	18	18	27
3	36	19	85
4	27	20	36
5	28	21	11
6	10	22	2
7	24	23	1
8	10	24	3
9	8	25	4
10	22	26	4
11	13	27	3
12	25	28	14
13	28	29	40
14	31	30	74
15	17	31	19
16	510	32	503

Third molars disclosed as missing clinically 2,017
Other teeth missing..... 620
Total number missing..... 2,637

The number of times that each individual tooth was found missing in the clinical examination of 780 mouths is given in Table 3.

Unerupted and impacted teeth have been followed with a great deal of interest. We have been very conservative in our judgment concerning these teeth, and many which we have called simply unerupted, especially in the third molar regions, will probably never erupt of their own accord, but will be watched over a period of from three to four years, provided they give no trouble. At the end of that time, we will, we believe, have gained some valuable knowledge as to the best advice to be given under these conditions. Concerning the impacted teeth, we have also been very conservative, and we do not class them as such unless we are absolutely sure that there is no possibility whatever of their erupting. In some cases, we find these teeth giving trouble at the time of examination; in others, they are simply filth catchers and are likely to be foci of infection. Then too, they are likely to cause destruction of second molars.

TABLE 4.—NUMBERS OF INDIVIDUAL TEETH WHICH ROENTGENOGRAMS SHOWED TO BE IMPACTED OR UNERUPTED IN EXAMINATION OF SEVEN HUNDRED EIGHTY STUDENTS

IMPACTED

Upper		Lower	
1	3	17	84
4	1	22	1
5	1	29	2
6	3	32	85
11	3		
16	9		

Total, 192

UNERUPTED

Upper		Lower	
1	330	17	215
15	1	32	217
16	306		

Total, 1,069

Table 5 shows the number of teeth devitalized, rarefied areas present and teeth extracted. Consider how many teeth in the mouths of young people would be saved provided more time were devoted to the education of parents and students, more careful examination by dentists, and, last but not least, a more general use of the roentgen rays.

During the last year and a half, we have noted a number of badly deformed arches, and have found by careful questioning of the students affected that these conditions have been treated lightly by

many dentists, and therefore the parents have neglected having them given attention. Students now begin to notice the deformities themselves when of college age, either from the standpoint of esthetics or decay, which, as we know, is ordinarily more active under these conditions. In many cases, these students are beyond the age when it is possible to get a satisfactory result from orthodontic treatment. Consequently, at this time, we would like to impress on the profession as a whole the importance of noting these conditions in the child, and for the dentist in charge to explain to the parents the importance of having these conditions corrected, not alone from the standpoint of appearance, but, most important of all, from the general health of the individual.

TABLE 5.—TEETH DEVITALIZED, EXTRACTIONS RECOMMENDED AND RAREFIED AREAS PRESENT IN SEVEN HUNDRED EIGHTY STUDENTS EXAMINED

	Teeth Devitalized	Rarefied Areas		Extractions Recommended
1	0	0	1	25
2	0	0	2	2
3	10	1	3	2
4	10	1	4	3
5	11	1	5	2
6	1	1	6	1
7	13	8	7	2
8	20	4	8	1
9	21	2	9	1
10	16	4	10	0
11	0	0	11	0
12	8	1	12	2
13	9	1	13	3
14	14	5	14	12
15	2	0	15	0
16	0	0	16	21
17	0	0	17	82
18	3	0	18	0
19	15	7	19	12
20	1	0	20	1
21	2	2	21	2
22	0	0	22	0
23	4	2	23	1
24	2	1	24	1
25	2	2	25	1
26	0	2	26	0
27	0	0	27	0
28	2	0	28	0
29	6	1	29	2
30	19	7	30	11
31	0	0	31	0
32	0	0	32	81
Total	192	53		272

In order to better prepare ourselves for giving advice on the mouth conditions of Carleton students, starting in the fall of 1932, we will not only study the mouth and roentgenograms for one year, but will also compare the roentgenograms and diagnoses made each year for the four years that the student is in college. Therefore, the roentgenograms taken for each student each year will be compared with those taken in the previous years, and all changes will then be noted, such as the presence of decay, devitalized teeth, pulps under large crowns, inlays, etc., unerupted, partially impacted and impacted teeth and arch deformities, as well as work which has been done. This will give us a thorough insight into just what the educational work in our dental service means to our students.

Our profession today, recognizing the importance of the mouth condition as it relates to general health, feels that we should have a closer working affiliation with medicine, and our work at Carleton has impressed this very strongly on our health service group. Therefore, for the year 1932-1933, the staff of the medical service has been increased, and we are laying our plans so that every student in whose mouth there is a likelihood of focal infection, such as from diseased gum tissue, devitalized teeth, etc., will be

given an especially thorough examination by the medical staff. All findings will be embodied in a report which will accompany the diagnosis sent to the student's doctor or dentist.

As this work is largely educational, we feel that there is a wide field for the dental hygienist and that her work should be primarily educational rather than at the chair. There may be a few exceptions to this but they are very few. Her field should be principally in institutions, such as hospitals and schools. We believe that public schools, colleges, universities and hospitals should by all means include on their staffs at least one properly prepared dental hygienist, working under the supervision of the dental society or the dentists in her community. In accordance with our opinion, a young woman to be properly prepared for the work should first of all have a full college course, this to be followed by training in the outlined courses in oral hygiene as offered by a number of dental colleges throughout the country. In order to show the practical application of this opinion, we selected one of the outstanding young women from last year's Senior class at Carleton College to take the dental hygiene course at the dental college of the University of Minnesota. She completed the two year course in one year, graduating with honors, and now has a fine position in one of the leading colleges in the State of Iowa. This fall of 1932, three more Carleton graduates are entering the dental hygiene course at the University of Minnesota. We have mentioned the dental hygienist in connection with our work as we consider that she will develop into one of the most important factors in the dental educational work in our colleges and universities, and that there will be a great demand within the next few years for young women with this training.

After carrying on this work for about a year and a half and thoroughly examining approximately 1,000 mouths, we have drawn the following conclusions:

1. A full mouth roentgen-ray examination is absolutely essential in the average oral examination.

2. A careful clinical examination should be made and conclusions drawn from both the clinical and the roentgenographic examinations. This should be followed by exercise of judgment, thorough consideration of the patient and careful dental operations by all men of the profession. Provided the foregoing is carried out to the best of our ability throughout the profession, there will be no need for anxiety concerning the introduction of panel dentistry or other forms of socialized dentistry which might tend to destroy initiative and lower the standard of the profession.

Some of the most important factors in the progress of our work up to this time at Carleton College are the perfect cooperation which we have had from President Cowling, Dr. Dungay and Dr. Stiles of the medical service, and Dr. Branstad and Miss Arny of the dental service; the way in which our seven Northfield dentists have cooperated; the fine attitude of the faculty toward our work, and the appreciation shown by students and their parents for the services rendered.

Following are statements in regard to the work. Dr. Branstad has shown a keen interest in the department and his thoroughness, personality and adaptability have added much to its success.

Northfield, Minn., June 9, 1932.

My dear Dr. Grey:

I feel that I should tell you that I regard the work of our dental clinic of highest importance to the welfare of the student body.

Not only does its work affect directly the present health of the students, but it encourages many of them, who otherwise would give little thought to their teeth, to take proper care of them in the future. I can already see quite a different attitude among the students toward this major factor of health.

It is gratifying to be able to state that dentists in the home cities of our students are recognizing the significance of our work and are congratulating us upon the fine quality of our x-ray examinations.

It affords me a great deal of pleasure to be able to pass on to you these hearty endorsements at the conclusion of the first full year of the clinic's activities.

Very sincerely yours,
(Signed) LINDSEY BLAYNEY,
Dean of the College.

To whom it may concern:

We, the dentists of Northfield, wish to express ourselves in regard to the dental diagnostic work which is being carried on at Carleton College health department.

We are cooperating in this work and feel that it has been a wonderful help in stimulating us to be of better service to our patients and to do the best work that we are capable of doing. It is of great educational value to the student and to others in the community, making each one realize the importance of better care of the mouth throughout life.

In the continuation of this work we feel that it will be carried out in as fair and impartial a manner as it has been in the past and we shall continue to cooperate fully with the health service to this end.

(Signed) C. W. LEE
H. H. GODBERSON
H. C. REMELE
F. A. HEIBERG
E. O. ERICKSON
LEONARD AMODT
RAYMOND D. KELSEY.

Carleton College, Northfield, Minn.,
August 22, 1932.

My dear Dr. Grey:

I should like to write you a few words concerning our work of the past year at Carleton. As a young graduate I have greatly appreciated the opportunity of studying and diagnosing cases under the guidance of experienced practitioners. I am setting forth here a brief evaluation of our activities as they appear to me.

The importance of thoroughness and meticulous attention to detail in every phase of dentistry has been strongly impressed upon me, together with the necessity, in diagnosis, for a complete series of radiograms in conjunction with carefully recorded clinical data. I have been made to realize the value to the patient of a thorough periodic check-up and the opportunities for real service, in the early detection of mouth conditions which, when given attention as advised, may prevent unnecessary oral morbidity with consequent impairment of health and efficiency. The yearly examinations are particularly justifiable when we are working with an age group where we find much decay and cases in which existing mouth conditions are preventing students from doing their best work.

The restorative work which has been placed in mouths can be studied and valuable lessons gained as to the practicability of various types of restorations and materials used. We will be able to observe closely at yearly intervals the evils of the loss of teeth without replacement and the behavior of impacted and unerupted teeth.

In addition to the experience in diagnostic work, I believe that the contact with patients and the conduct of the office should be considered. As in any other dental office the importance of conducting the work as carefully as possible along with the maintenance of a high standard of cleanliness cannot be overemphasized.

Not only has the experience of the past year been of value from a professional point of view, but the associations with other members of the administrative staff and faculty have been very stimulating. The atmosphere of a college is inspiring and furnishes a pleasant environment in which to work.

Interesting as the past year has been, the coming year promises to be even more so. The experience we now have will naturally expedite the work of the future. The comparison of the new diagnosis with previous records of returning students will give an idea of what we may expect when a series of examinations over a period of four years is available.

The work has been most interesting and enjoyable, and I hope that we may continue having the same hearty cooperation from the faculty and students as we have had in the past.

Very respectfully yours,
(Signed) WILLIAM BRANSTAD, D.D.S.

DENTAL HEALTH IN MASSACHUSETTS

By ELEANOR GALLINGER McCARTHY,* B.S., D.H., Boston, Mass.

THE dental health program in Massachusetts is the oldest in the country. From the beginning, the dental profession has guided its development. Centered in the department of public health, it has become highly organized, closely integrated and many-sided.

Every new project, every new piece of educational material is examined, criticized and approved by an advisory committee of representative groups of the dental and dental hygiene professions as follows: Tufts College Dental School; Harvard University, College of Dentistry; Forsyth-Tufts Training School for Dental Hygienists; Massachusetts School Dental Association; Massachusetts Dental Society; Massachusetts Dental Hygienists' Association and Massachusetts Dental Hygiene Council.

The Massachusetts School Dental Association, represented on the committee, includes clinicians, hygienists and assistants. As a clearing house for school dental problems, its bulletin carries announcements, reports and field news. The bulletin reaches superintendents of schools, public health nurses and health officers, as well as members.

The printed policy for dental clinics and community dental programs drawn up by the committee forms the basis of the advisory and consulting service to communities. Plans and details for the administration of community dental programs are a part of the department's school hygiene handbook.

Contrary to the practice in most other states of having a separate division, the dental health program in Massachusetts is an integral part of all the activities of the division of child hygiene. We have found that a great deal more can be accomplished and at less expense to the tax payers if the dental health director functions as a special consultant to the other members of the division. Public health nursing, nutrition and dental hygiene have this in common, that they are an essential part of any program in maternal, infant, preschool, school and adult hygiene.

Dental health work in communities is organized, stimulated and promoted in two different ways. 1. By direct contact between community workers and the dental hygiene consultant. This method is similar to that used in many states. 2. By contact with local people through the public health nursing consultants. This method is used more frequently and is more typical of the close coordination that is so characteristic of the work in Massachusetts.

The public health nurses each have a section of the state with which they become intimately acquainted. They offer consulting service in public health nursing and are interested in developing all phases of child hygiene in their districts. The special consultant in dental hygiene,

*Consultant in Dental Hygiene, Massachusetts Department of Public Health.

by working through the nurses, fits the dental program to the needs of each individual community, avoids duplication of effort and conflicts between projects and speeds results.

We consider nutrition fundamental to dental health. For this reason, we cooperate with the home economics teachers, home demonstration agents and nutritionists throughout the state.

We believe that the public health nurse is responsible for the teaching of dental hygiene in the home. For this reason, we cooperate with staff directors and teachers of undergraduate and graduate courses in public health nursing. Since educational authorities have agreed that it is the province of the teacher to teach dental hygiene in the classroom, we supply accurate teaching material through the state department of education.

In Massachusetts, the dental health work is of many types. We have a large number of clinics, ranging from the famous Forsyth Infirmary to the typical traveling clinic with portable equipment. Thirty per cent of the cities and towns in the state now offer some dental clinic service to the poor child. The majority of the clinics have adopted the state plan of concentrating on the lower grades with as much follow-up work as funds will permit. The more progressive clinics include preschool children, three clinics caring for preschool children exclusively. There is one clinic for prenatal patients in Springfield under the auspices of the Junior League.

The dental certificate plan used by several states and borrowed by us in its entirety in 1927 is used in 68 per cent of our communities. We consider it the fundamental plan for school dental work. The accompanying table shows the growth of dental corrections under this program.

	1927-28	1928-29	1929-30	1930-31	1931-32
Number of cities and towns reporting.	78	126	178	226	243
Elementary school population for Massachusetts	560,065	491,944	483,833	487,480	485,957
Dental certificates awarded by:					
School dentist at examination	Not reported separately	Not reported	Not reported	14,839	25,431
Clinic dentist		23,052	45,989	51,624	64,106
Family dentist		27,296	44,774	64,052	38,260
Total number of children receiving certificates	25,949	50,348	90,763	130,515	127,797
Elementary school population receiving certificates	4%	10%	18%	25%	25%

Dental hygienists here are carrying on various types of programs. These include full-time clinic assistance, full-time prophylactic service, full-time educational work and several variations of programs divided between clinic assistance, school inspections and preschool conference teaching.

A generalized program for a public health dental hygienist is being developed

as part of the program of the Southern Berkshire Health District.[1] In this program, the dental hygienist (guided by the dental advisor to the unit) makes school inspections, assists teachers, has conferences with mothers at preschool conferences, assists the health officer with administrative details of clinic service for the needy and acts as a special consultant to the staff nurses.

The department conducts demonstration well child conferences for preschool children throughout the state. The average number of towns reached each year is forty-seven and the average number of children examined is 1,974. The staff consists of a pediatrician, a nutritionist and a dental hygienist. The dental hygienist does not see children under 2 years of age. Prophylactic treatments are not given. The dental hygienist explains to the parent the conditions found in the child's mouth, the relation of good nutrition to the teeth, the importance of early, regular dental care and the proper method of toothbrushing. A joint conference of the nutritionist and the dental hygienist is held concerning each child with active dental caries. A special diet rich in calcium, phosphorus and vitamins A, D and C is suggested to the parents of these children.

Informational files of the dental activities in every community are kept and a registry service is conducted for both school dentists and dental hygienists.

The general educational program is typical. Approximately 350,000 dental flyers are distributed each year. In an attempt to follow the precept of "keeping the child together," we have included our newest dental information in the department's general booklets "Baby and You" and "One to Six."

Moving picture films are lent, the Eastman classroom films being recommended especially. Requests for lectures are met either by the division or through Harvard Dental School or Forsyth Dental Infirmary.

We keep in touch with dental educational material, commercial or otherwise, as it is published, and assist in its distribution if it meets the requirements set by health education authorities.

SUMMARY

Massachusetts stands for:

The close cooperation of all agencies interested in dental health.

An official program of an advisory and educational nature directed by the dental, dental hygiene and public health professions.

Regular dental care for all prospective mothers and preschool and school children, either by the family dentist or at clinics supported by town, city or county.

Employment of the generalized public health dental hygienist as a special helper to the public health nurses and the classroom teacher.

The routine use by all schools of the dental certificate plan.

Regular dental care and good dental nutrition for the children in the state sanatoriums for tuberculosis.

The widest possible use of existing dental educational material.

1. Grant from the Commonwealth Fund.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

New Surgical Procedure for Correction of Prognathism: According to Pettit and Walrath (*J. A. M. A.*, Dec. 3, 1932), the flexibility of the teeth in the hands of the skilled orthodontist is so great that normal occlusion can be restored in the ordinary cases of prognathism and the average degree of facial deformity can be compensated for at the same time. In the more extreme cases, it is not possible to make these corrections without the aid of some surgical procedure on the bone. The operation heretofore has consisted of the removal of a portion of the body of the mandible, or a section through the lower part of the ramus opposite the last molar tooth, permitting a backward slide of the body of the bone. The fragments are then fastened together with wires or plates or other foreign material. With this technic, the danger of infection from an oral communication is always imminent and from injury to blood vessels and nerves obvious. No one has ever reported a series of successful cases. The authors advocate for the correction of prognathism an operation that has been employed in ankylosis of the temporomandibular articulation, illustrating the practicability of the technic by the report of a case of unilateral prognathism in a girl, aged 14. In describing the application of "arthroplasty" to prognathism, the authors say: "The chin portrudes usually because of obtuseness of the mandibular angle and not of an increased body length. On account of the contour of the condyloid head and the environment of the glenoid cavity, the mandible has only a forward and not a backward movement from the normal resting position. The production of a supplementary movable point just below the temporomandibular articulation permits a 'backward bend.' This point does not disturb the attachments of any muscles and therefore does not impair the muscle function. Normal apposition of the jaws is involuntary and ensues naturally when any existing impediment is removed. The new joint removes the backward impediment and occlusion naturally ensues. The muscles bring the teeth into alinement, at first by voluntary effort, later by involuntary or unconscious action." The patient, after a few months, experienced difficulty in demonstrating the original deformity. In order to insure the correct position, form and function of the new joint or nonunion, as it might be called, of the fractured condyloid process, and in order that it may better achieve the results desired, the teeth are so wired as to maintain the correct position during the healing process. The advantages of this operation of "the construction of an additional joint in the condyloid process with or without supplementary orthodontic treatment" are summarized as: 1. No destruction of nerve and blood supply. 2. No tooth loss. 3. No loss of body of bone. 4. No wires nor other foreign material left in tissues. 5. No danger of devitalization of teeth. 6. No visible scar, as this incision is within the hair line. 7. No loss of sensation over the course of the mental nerve. 8. No danger of infection due to a chance communication with the oral cavity. 9. Less bone trauma and destruction. 10. Added mobility to mandibular function.

Surgical Treatment of Prognathism by Resection of the Condyles: It is first necessary to establish that the case is really one of prognathism, and that there is no question of jumped bite or other protrusion of dental origin. True prognathism is a bony deformity which may be due to an elongation of the bone, to a widening of the mandibular angle, or to a curvature of the neck of the condyle. In many cases, all these modifications exist together, each contributing something to the malformation. Mental and alveolar types of prognathism may be observed: often the alveolus [alveolar process] plays the predominant part and more rarely the chin. The condition is only to be considered a surgical one when orthodontic methods have been tried and found unavailing. The principal operations which have been designed for correcting progna-

thism are three in number. The oldest consisted of resection of part of the horizontal portion of the mandible. After this had been done on both sides, the anterior portion could be pushed backwards, and fixed in such a position that after healing a shortened jaw would be obtained. It is unnecessary to point out the seriousness of an operation which involves a double fracture of the jaw, with loss of substance and free communication with the oral cavity. In addition the inferior dental artery and nerve on either side are cut; there is a risk of a false joint being formed, and there are scars. The total loss of the anterior part of the mandible after this operation has been recorded. The next method is chiefly practiced in the German countries by Pichler, Pohl, Ernst and others. It consists in dividing the ascending ramus of the mandible above the point of entry of the inferior dental artery and nerve, and pushing back the lower portion of the jaw, which is allowed to heal in an improved position. The third method as practiced by Jaboulay and the author consists in cutting through the neck of the condyle and extracting the latter. By this means sufficient looseness is obtained in the joint for the jaw to slide backwards, and if a proper amount of bone has been removed, the prognathism will have been corrected however severe the case. The author has performed this operation forty-seven times, and finds that an absolutely perfect result is always obtained, provided the patient undergoes the necessary prosthetic treatment after resection. In one case only, where a woman obstinately refused to wear any apparatus at all, she was left with an open bite of about a centimeter.—*L'Odontologie*, July, 1932; abstr. *D. Rec.*, December, 1932.

Asthma Due to a Local Anesthetic: A case of bronchial asthma due to cocainization is reported by George L. Waldbott (J. A. M. A., Dec. 3, 1932). A girl, aged 12, who had perennial asthma, but had been relieved for the past fourteen months by treatment with pollen extract, was referred to a rhinologist because of frequent nosebleed. When the mucosa of the septum was touched with a cocaine crystal for the purpose of anesthesia, the patient had a very severe paroxysm of asthma. A later attempt had the same result. In a second case referred to by the author, death ensued in a young woman when, during an extremely severe paroxysm of bronchial asthma, local anesthesia of the posterior portion of the nose with procaine hydrochloride was attempted. The author believes that certain unexplained deaths following local anesthesia may be due to marked sensitivity of the patient to the antigen, rapid absorption and a dosage above the individual sensitivity of the patient.

Mottled Enamel: We wish to call attention to a situation in connection with public health activities which in some respects has unique features. Some years ago, it was found that the permanent teeth of all the children born in Chetopa, Kansas, were afflicted with what is known as "mottled enamel." Recent investigations have shown that this pathological condition, which occurs in many districts of the United States, is induced by the presence of fluorine in the drinking water. The water of the artesian well which supplies Chetopa was found to contain over 9 parts per million of fluorine, an amount which invariably leads to damaging and disfiguring lesions of the dental enamel. For several years, Dr. J. Scott Walker, a practicing dentist in that city, called public attention to the dangers of the situation with the result that it was proposed to bond the city to the amount of $25,000 for a new water supply which would be free from fluorine. Last August, this proposal was voted on but defeated, which meant that the dental defects would continue to develop in succeeding generations. Dr. Walker has continued his agitation and has brought it about that the monthly water bills bear the legend: "This water is unfit for consumption by children." It is clear that the matter is by no means settled. This incident is of interest to public health authorities, not only because the officials of this community decided to save money rather than to eradicate a menace to the health of the community but even more so because it illustrates what can be done by an energetic and persistent individual in the face of a lack of cooperation. The ingenious method of calling direct attention of the residents to the limitation in potability of the water might be of service to others who are concerned with similar problems.—*Am. J. Pub. Health*, January, 1933.

MISCELLANY

BOOK REVIEWS

Histopathology of the Teeth and Their Surrounding Structures. By Rudolf Kronfeld, M.D., Professor of Special Histopathology, Director of Department of Research, Chicago College of Dental Surgery, Dental Department of Loyola University, Chicago, Illinois; Former Assistant at the Dental Institute of the University of Vienna, Austria. Illustrated with 385 engravings. 479 pages. Price, $7.00. Published by Lea & Febiger, Philadelphia, Pa.

One of the distinguishing characteristics of the present volume relates to the difference in the methods of preparing the illustrative work from those of previous writers. For the most part, specimens of the investing structures beyond the root ends have in the past been prepared from animal tissues, such as those from sheep and dogs, thus leaving an open question as to a possible comparison between these tissues and those of man. The author of the present volume has settled this matter by preparing most of his material from human tissue, which, though much more difficult, has the merit of greater accuracy in results.

Another departure from previous custom is noted in the attempt to tie up the experimental findings with clinical experience, instead of merely stating laboratory facts and making no clinical application as is done in most books of this kind. The latter plan has sometimes been called the "scientific method," employing the term with the inference of commendation, but if we understand the true object of a book, it is to do the greatest good to the greatest number, and unquestionably the clinical appeal will reach a wider circle of readers than the mere recital of scientific experiment. In fact, it is safe to assume that the present trend is in the direction of relying more and more on clinical experience in deciding any question of pathology and less and less on mere laboratory experimentation. In this view of the case, there is a distinct value in the author's present method of presenting his subject.

The illustrative work in this volume is very profuse and most excellent, and it supplements the text in a very acceptable manner. Some of the sections are unique, and in their perfection they are very convincing. All in all, the work is worthy of the greatest commendation, and the publishers as usual have produced a very attractive and well executed piece of the printer's art.

Moderne Orthodontische Therapie. By Dr. Gustav Korkhaus. 480 illustrations. 209 pages. Published by Hermann Meusser, Berlin, Germany.

This book is published in the German language which, of course, limits its usefulness to the English reader. At the same time, there is much of value to be obtained from an examination of the illustrations, which are really of an unusual character. We do not remember having seen anywhere a finer lot of illustrations of this very interesting subject than are to be found in this volume, and it is hoped that the book may some day be published in the English language.

DIVERSIFIED PROGRAM FOR CENTENNIAL DENTAL CONGRESS

It is axiomatic that the success of any dental meeting depends primarily on the excellence and diversity of the scientific program. This thought has dominated the activities of the joint committee which is preparing the program for the Chicago Centennial Dental Congress. The Diamond Jubilee of the American Dental Association will be held in conjunction with the Congress at the Stevens Hotel in Chicago, Aug. 7-12, 1933.

Visitors to this unexcelled dental meeting will have opportunity to review the historical background of dentistry in the thousands of items which will be displayed in the scientific exhibits, and attend sessions at which scientific papers, clinics, and lecture demonstrations will be presented by authorities in the various fields of dental practice from all parts of the world. Dental leaders from the United States will predominate, of course, but many foreign countries will also be represented. Practically every state in the Union will send representative leaders, while the following foreign countries will send their talent to add to the brilliance of the meeting: England, France, Germany, Canada, Austria, Japan, Peru and Switzerland.

While the selection of essayists has been completed, it is probable that the final program will include more foreign representatives among those who will provide the greatest dental program of history.

In addition to the formal presentations, there will be more than 1,000 clinics offered by as many dentists from practically every major country in the world. This will be by far the largest and most diversified clinical program ever staged. A veritable encyclopedia of dental knowledge and "practical hints" will be available to visitors in this extremely popular mode of presentation.

All the detailed information concerning the meeting will be brought to the dental profession of America in the Preliminary Official Program, which will be mailed free of charge to every dentist about May 1, 1933, before the opening of the Congress. It will be the most elaborate and complete program of its kind ever issued. In its pages will be found the program of ten general sessions, of sixty-four section meetings and clinics, with synopses of papers and lecture clinics; also a complete list of clinicians and the titles of clinics, and complete information concerning the historical and scientific exhibits. There will be a preview of the commercial exhibits, a digest of the sports activities, data concerning the executive and legislative sessions of the American Dental Association and descriptions of the popular dental exhibit in the Hall of Science of A Century of Progress Exposition, where it is anticipated that more than 50,000,000 persons will be told the story of dental progress. Useful information regarding hotels, restaurants, and transportation will also be given.

Replete with illustrations and descriptive matter, the program is expected to tell the story of the Congress so that every member of the American Dental Association will feel a compelling urge to accept the cordial invitation to come to Chicago with his family to enjoy the benefits, not only of this unusual Congress, but of A Century of Progress Exposition as well.

CONSULTANTS AND SPECIALISTS FOR PANEL PATIENTS

The national insurance system provides only a general practitioner service for panel patients. The provision of a consultant service has often been discussed but the financial depression has proved a barrier. Panel patients can of course obtain the services of consultants by paying for them, and the British Medical Association has prepared a scheme by which this can be done at a modified fee. The closest cooperation will be maintained with the patient's panel physician, whose approval will be necessary and to whom the consultant's opinion will be communicated. A consultant's list of consulting physicians and surgeons in London whose advice will be available for a fee of $5 has been drawn up by the association. The list contains more than 400 names and includes every kind of specialist. A similar reduction of fee has always been possible for necessitous patients. But the scheme has the advantage that the attending practitioner will not have in each case to correspond with the consultant in order to arrange for a reduced fee. At present, either this is done or the patient attends the outpatient department of a hospital and the consultant receives nothing for his services. Under the scheme, the patient will be saved the great waste of time involved by attendance at a hospital. A number of benefit societies have already established for their members a list of consultants willing to see members at a reduced fee. But the British Medical Association objects to such lists on the following grounds: 1. The list is a closed or restricted one, controlled by a nonmedical organization. 2. The circulation to members of a particular society as to arrangements is contrary to the dictum of the General Medical Council. 3. There is no income limit, except so far as this is represented in the status of the particular society. In view of the list of consultants established by the association, on which all physicians who satisfy the required criteria may be placed, it is hoped that such closed panels will be abolished and that physicians associated with them will have their names removed.—London letter, *J. A. M. A.*, Dec. 17, 1932.

OFFER WAR DEBT LITERATURE

Recent developments in the intergovernmental debt problem and their economic significance bring this question to the fore in the minds of all who are interested in economic recovery. The Committee for the Consideration of Inter-Governmental Debts, of which Alfred P. Sloan, Jr., president of General Motors Corporation, is chairman, has a number of articles on this important problem available, without cost. These include:

Report of Committee of Economists on Inter-Governmental Debts, Aug. 24, 1932.

Commodities and Inter-Governmental Debts, by C. T. Revere, Nov. 23, 1932.

Shall We Deflate Some More? by Walter Lippmann; reprinted from the *New York Herald-Tribune,* Nov. 23, 1932.

Cotton Authorities Urge Debt Revision as Aid to Recovery. Leading Industrialists Urge Extension of Moratorium, Dec. 12, 1932.

Not Only Cotton and Wheat Involved; reprinted from *The Texas Weekly,* Nov. 26, 1932.

Towards a Business Solution, Oct. 3, 1932.

The War Debt Problem, by Frank Simonds.

Making Selfishness Pay; editorial and cartoon reprinted from Jan. 7, 1933, issue of *Collier's Weekly Magazine.*

Let's Park Our Prejudice; editorial and cartoon reprinted from Jan. 21, 1933, issue of *Collier's Weekly Magazine.*

Address of Frederic R. Coudert, member of the Institute of International Law, over the Columbia Broadcasting System, Dec. 3, 1932.

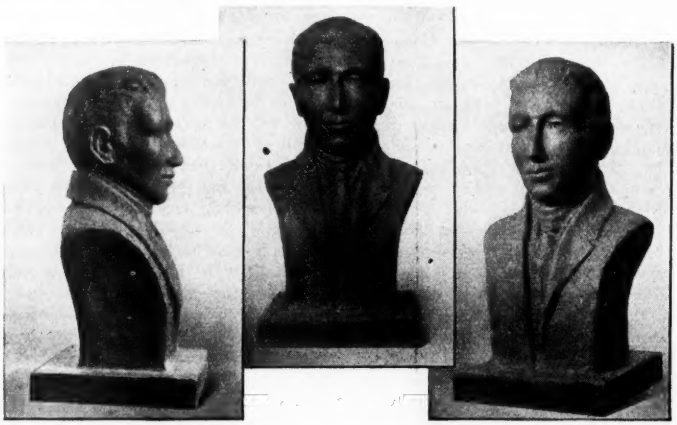
Address by Senator Borah, U. S. Senate, Jan. 4, 1933.

Copies of these reprints can be secured from the Committee for the Consideration of Inter-Governmental Debts, 330 West 42d Street, New York City.

MOTHER'S DAY AND THE MATERNITY CENTER ASSOCIATION

Since 1914, we have celebrated the second Sunday in May as Mother's Day, dedicated to the most idealized, the best loved, the most important person. This year, the Maternity Center Association of New York challenges us—you in your home and me at my editor's desk—to pledge ourselves, in the name of our own mothers, to make motherhood safe for all mothers.

To become a mother is the normal exercise of a great function. It should not be dangerous but safe, if the mother and the father act with plain good sense and the mother has proper medical supervision and care.



Bust of Lorenzo Carter, the work of Dr. Gentilly, of Cleveland

Many greater hazards of our daily existence have been reduced—hazards of industry, of travel, of epidemic diseases. Yet those hazards of childbirth, which can be speedily and enormously reduced by improving maternity care, are as great as they were twenty years ago.

So it is not enough to send flowers and telegrams and letters, to think kindly and pray earnestly for our mothers on this day, nor to listen to sermon and tune-in on radio programs that make us choke up at the thought of motherhood. None of us is free in conscience to stop at that, while every year sixteen thousand mothers die in childbirth and ten thousand of these deaths could be prevented.

If you ask "Who can reduce the hazards of motherhood?" you will find yourself among the number of those who can. The husband and wife can; the physician can; the nurse can; the medical educator can; the public can. Every one of us belongs in one or more of these groups, and the first step toward action is knowledge.

When women know more, they will go to a good doctor or clinic as soon as they find themselves pregnant and will make a regular visit every two or three weeks after that. When men know more, they will help their wives to find the best doctor, to follow his advice, and to get the food and rest and contentment that are needed. Doctors themselves are already demanding of their own profession more and better obstetric education in medical and nursing schools. Meanwhile the public is not yet awake. Let us wake it; for in the words of Abraham Lincoln, "Public sentiment is everything. With public sentiment, nothing can fail; without it, nothing can succeed."

The citizens of other nations take better care of their mothers than we do. An intolerable thought to our American pride! Our country loses more women in childbirth than any other country loses. Let us pass this information on to our relatives and friends. Let us discuss it. It is worthy of discussion. And let us remember to say that five-eighths of this loss could be prevented.

On Mother's Day and before and after Mother's Day, let each one of us personally accept the challenge of Mother's Day and resolve that every American Mother shall have opportunity for proper care as she enters on the most purely creative and one of the most noble works possible to human beings—the generating of new life. Here is a cause worth fighting for!

AIDA DE ACOSTA BRECKINRIDGE

NEWS

The Review of Orthodontia: A new publication in the interests of orthodontia has just been issued, to come out bimonthly. It is called *The Review of Orthodontia,* and it is conducted by Martin Dewey, editor, and J. A. Salzmann, managing editor. The first issue is just out and it is a publication of forty-eight pages. The subscription price is $5.00 a year, $9.00 for two years in advance. It is issued at 17 Park Avenue, New York.

Bust of Late Major Carter of Cleveland Work of Dr. Gentilly: The bust of the late Maj. Lorenzo Carter, of Cleveland, reproduced on page 558, is the work of James V. Gentilly, D.D.S., of Cleveland. The bust now stands in the lobby of the new Hotel Carter in Cleveland, where it was unveiled at the formal opening of the hotel, December 16.

Rhode Island Society Elects Officers: Following is a list of the newly elected officers of the Rhode Island State Dental Society: Thomas S. MacKnight, Newport, president; Harry F. McKanna, West Warwick, vice president; William J. McGovern, Cranston, treasurer; Charles J. Smith, Providence, secretary; Ambrose H. Lynch, Providence, editor; Morris Lebow, Providence, librarian.

DEATHS

Cobey, Alexander Dunnington, Stafford County, Virginia; Baltimore College of Dental Surgery, 1870; died November 27; aged 85. Dr. Cobey retired from practice in 1925. A son, Dr. Howard Prout Cobey, and three daughters survive.

Harris, Edward Ewel, Dental Corps, U. S. Navy; Chicago College of Dental Surgery, 1904; died recently. Burial was at Carthage, Mo.

House, David A., Indianapolis, Ind.; Indiana University School of Dentistry, 1894; died recently.

Moore, O. C., Chicago, Ill.; Northwestern University Dental School, 1916; died, of pneumonia, February 13; aged 48. The widow, two sons and a daughter survive.

Nevius, George W., Mobile, Ala.; Chicago College of Dental Surgery, 1899; died February 17. Dr. Nevius practiced for twenty-seven years in Chicago.

Pickard, Allen L., Kansas City, Mo.; Kansas City Dental College, 1918; died, November 8.

Schultz, Louis C., Chicago, Ill.; Northwestern University Dental School, 1917; died, December 21, of pneumonia; aged 41. The widow, three daughters and one son survive.

Walker, Donald A., Astoria, Ore.; North Pacific College of Oregon, School of Dentistry, 1917; died, November 26; aged 38. Dr. Walker served as a first lieutenant in the World War. He is survived by the widow, a son and a daughter.

Wellman, H. W., St. Louis, Mo.; Temple University School of Dentistry, 1889; died, November 13.

Westhoff, G. H., St. Louis, Mo.; Washington University School of Dentistry, 1914; died, November 19.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association in conjunction with the Chicago Centennial Dental Congress, Chicago, Ill., August 7-12.

American Association of Dental Schools, Chicago, March 20-22.

American Board of Orthodontia, Oklahoma City, Okla., April 17-18.

American Dental Society of Europe, Le Touquet, France, April.

American Society of Oral Surgeons and Exodontists, Chicago, August 4-5.

American Society of Orthodontists, Oklahoma City, Okla., April 19-21.

Alumni Society of Philadelphia Dental College and Dental School of Temple University, Philadelphia, May 1.

Buffalo University School of Dentistry Alumni Association, Buffalo, N. Y., March 1-3.

Dental Alumni Association of American University of Beirut, Syria, June.

Eastern Association of Graduates of Angle School of Orthodontia, New York City, May 1-2.

Fédération Dentaire Internationale, Edinburgh, July 22-27.

First District Dental Society of New York (Prosthodontia Section), New York City, March 27.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southern Academy of Periodontology, Atlanta, March 15.

Southwestern Pennsylvania Eleventh District Dental Society, Uniontown, March 29.

St. Louis University Dental Alumni Reunion, St. Louis, Mo., March 31-April 1.

Thomas P. Hinman Midwinter Clinic, Atlanta, Ga., March 13-14.

Tufts College Dental Alumni Association, Boston, Mass., March 8.

Ontario Dental Association, Toronto, May 15-18.

American Dental Assistants Association, Chicago, August 7-12.

American Dental Hygienists' Association, Chicago, August 7-12.

Dental Hygienists Association of State of New York, Syracuse, May 11-13.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

April

Alabama, at Birmingham (24-26).
California (State), at Del Monte (20-22).
Connecticut, at Bridgeport (19-21).
Kansas, at Topeka (24-26).
Kentucky, at Louisville (3-5).
Louisiana, at New Orleans (27-29).
Michigan, at Grand Rapids (10-12).
Montana, at Billings (20-22).
New Jersey, at Atlantic City (26-28).
Oklahoma, at Oklahoma City (17-20).
Tennessee, at Knoxville (27-29).
Virginia, at Richmond (24-26).

May

Illinois, at Peoria (9-11).
Indiana, at Indianapolis (15-17).
Iowa, at Des Moines (2-4).
Maryland, at Baltimore (1-4).
Massachusetts, at Boston (1-4).
Missouri, at St. Louis (15-17).
Nebraska, at Omaha (15-18).
New York, at Syracuse (11-13).
North Dakota, at Valley City (16-17).
Pennsylvania, at Philadelphia (2-4).
South Carolina, at Columbia (22-23).
Texas, at San Antonio (9-11).
Vermont, at Burlington (17-19).
West Virginia, at Charleston (15-17).

June

Arkansas, at Little Rock (5-7).
California (Southern), at Los Angeles (5-7).
Colorado, at Colorado Springs (19-21).
Georgia, at Savannah (12-14).
Maine, at Rangeley Lake (22-24).

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

Nevada, at Reno (3).
New Hampshire, at North Conway (1-2).
North Carolina, at Chapel Hill (6-8).
Oregon, at Portland (21-24).
Utah, at Ogden (1-3).
Washington, at Yakima (June 30-July 2).

STATE BOARD OF DENTAL EXAMINERS

California, at San Francisco, May 22, and Los Angeles, June 19. K. I. Nesbitt, Secretary, 450 McAllister St., San Francisco.

Florida, at Jacksonville, June 21. R. P. Taylor, Secretary, Jacksonville.

Georgia, June 1. R. C. Coleman, Secretary, Atlanta.

Indiana, at Indianapolis, June 14. J. M. Hale, Secretary, Mt. Vernon.

Iowa, at Iowa City, May 29-June 1. Hardy F. Pool, Secretary, Mason City.

Kentucky, at Louisville, June 7-10. Robert L. Sprau, Secretary, 970 Baxter Bldg., Louisville.

Maine, at Augusta, June 26-28. Alton H. Swett, Secretary, 192 State St., Portland.

Massachusetts, at Boston, June 13-16. W. Henry Grant, Secretary, State House, Boston.

New Jersey, at Trenton, June 26-July 1. John C. Forsyth, Secretary, 148 W. State St., Trenton.

Pennsylvania, at Philadelphia and Pittsburgh, June 21-24. W. A. McCready, Secretary, Highland Bldg., Pittsburgh.

Vermont, at Montpelier, June 26-28. H. B. Small, Secretary, Burlington.

Virginia, at Richmond, June 13. John M. Hughes, Secretary, Medical Arts Building, Richmond.

NORTH DAKOTA STATE DENTAL ASSOCIATION

The North Dakota State Dental Association will hold its annual meeting May 16-17, at Valley City.

WILLIAM S. SHAW, *Secretary*
Fargo

NEW JERSEY STATE DENTAL SOCIETY

The sixty-third annual session of the New Jersey State Dental Society will be held April 26-28, at the Hotel Ambassador, Atlantic City.

F. K. HEASELTON, *Secretary*
223 East Hanover St.
Trenton

NEW HAMPSHIRE DENTAL SOCIETY

The fifty-sixth annual meeting of the New Hampshire Dental Society will be held at the Hotel Randall, North Conway, June 1-2.

EDWIN S. KENT, *Vice-President*
Portsmouth

LOUISIANA STATE DENTAL SOCIETY

The annual meeting of the Louisiana State Dental Society will be held at the Roosevelt Hotel, New Orleans, April 27-29.

JULIAN S. BERNHARD, *Secretary*
Medical Arts Bldg.
Shreveport

MAINE BOARD OF DENTAL EXAMINERS

The Maine Board of Dental Examiners will hold an examination for registration of dentists and oral hygienists at the State House, Augusta, June 26-28. Application must be filed ten days before date of examination. For further information, address

ALTON H. SWETT, *Secretary*
192 State St.
Portland

VERMONT BOARD OF EXAMINERS

The Vermont Board of Dental Examiners will meet June 26-28, in the State House, Montpelier, to examine applicants for license to practice dentistry and dental hygiene. All applications, accompanied by examination fee, must be in the hands of the secretary at least ten days before the meeting. For further information, address

H. B. SMALL, *Secretary*
Burlington

THE PENNSYLVANIA STATE BOARD OF DENTAL EXAMINERS

The Pennsylvania State Board of Dental Examiners will hold its next examinations June 21-24, at Philadelphia and Pittsburgh.

W. A. MCCREADY, *Secretary*
Highland Bldg.
Pittsburgh

VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the Virginia State Board of Dental Examiners will be held at the Medical College of Virginia, Richmond, June 13. Applications, with fee and photograph, must be filed fifteen days before

the examination. For further information, address

JOHN M. HUGHES, *Secretary*
Medical Arts Bldg.
Richmond

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

The fifteenth annual meeting of the American Society of Oral Surgeons and Exodontists will be held in the Stevens Hotel, Chicago, August 4-5.

HARRY BEAR, *Secretary*
Professional Bldg.
Richmond, Va.

SOUTHERN ACADEMY OF PERIODONTOLOGY

The next meeting of the Southern Academy of Periodontology will be held at the Atlanta-Biltmore Hotel, Atlanta, Ga., March 15.

JAMES A. SINCLAIR, *Secretary*
Legal Bldg.
Asheville, N. C.

PROSTHODONTIA SECTION OF THE FIRST DISTRICT DENTAL SOCIETY OF NEW YORK CITY

The future scientific meetings of the Prosthodontia Section of the First District Dental Society of New York City will be held at the Hotel Pennsylvania. The next meeting will be held March 27, at 8:15 p. m.

LOUIS I. ABELSON, *Chairman*
310 W. 72d St.
New York City

SOUTHWESTERN PENNSYLVANIA ELEVENTH DISTRICT DENTAL SOCIETY

The annual meeting of the Southwestern Pennsylvania Eleventh District Dental Society will be held at the Uniontown Country Club, Uniontown, March 29.

R. R. ELDER, *Secretary*
304 Nat. Dep. Bk. Bldg.
South Brownsville, Pa.

GEORGIA STATE BOARD OF DENTAL EXAMINERS

The next examination of the Georgia State Board of Dental Examiners will be held June 1.

R. C. COLEMAN, *Secretary*
Atlanta

OHIO STATE DENTAL BOARD

The next examination of the Ohio State Dental Board will be held at the College of Dentistry, Ohio State University, Columbus, the week beginning June 26. All applications must be in the hands of the secretary at least ten days before date of examination. For further information, address

MORTON H. JONES, *Secretary*
1553½ North Fourth St.
Columbus

FLORIDA STATE BOARD OF DENTAL EXAMINERS

The Florida State Board of Dental Examiners will hold its annual examination June 21, at Jacksonville. For information and application blanks, address

R. P. TAYLOR, *Secretary*
Jacksonville

INDIANA STATE BOARD OF DENTAL EXAMINERS

The Indiana State Board of Dental Examiners will meet June 14 at the State House, Indianapolis, for the purpose of examining all applicants with proper credentials. All applications should be in the hands of the secretary of the board one week before the meeting. For further information, address

J. M. Hale, *Secretary*
Mt. Vernon

MASSACHUSETTS BOARD OF DENTAL EXAMINERS

The Massachusetts Board of Dental Examiners will hold an examination for registration of dentists and hygienists in the City of Boston, June 13-16. Applications must be filed with the secretary at least ten days before date of examination. For further information, address

W. Henry Grant, *Secretary*
Room 141, State House
Boston

EASTERN ASSOCIATION OF GRADUATES OF THE ANGLE SCHOOL OF ORTHODONTIA

The annual meeting of the Eastern Association of Graduates of the Angle School of Orthodontia will be held in the Vanderbilt Hotel, New York City, May 1-2.

Frederic T. Murlless, Jr., *Secretary*
43 Farmington Ave.
Hartford, Conn.

ALUMNI SOCIETY OF PHILADELPHIA DENTAL COLLEGE AND DENTAL SCHOOL OF TEMPLE UNIVERSITY

The seventieth annual alumni day and reunion of the Philadelphia Dental College and Dental School of Temple University will be held in the Professional Schools Bldg., Philadelphia, May 1. May 2-4, the Pennsylvania State Dental Society will hold its sixty-fifth annual meeting in the Bellevue-Stratford Hotel, Philadelphia.

James W. Craig, *Chairman*
Publicity

ST. LOUIS UNIVERSITY ALUMNI, SCHOOL OF DENTISTRY

The annual reunion of the St. Louis University Alumni of the School of Dentistry will be held in the university gymnasium, 3672 West Pine Blvd., March 31-April 1.

CLASS OF 1923, N. Y. U. COLLEGE OF DENTISTRY

The class of 1923, N. Y. U. College of Dentistry, will celebrate its tenth anniversary with a reunion dinner at the Fraternity Club Bldg., April 28, at 7:30 p.m. Members of class who have not received notice of this meeting are asked to forward addresses to

Max J. Futterman,
2090 Bryant Ave.
Bronx, New York City

THE DENTAL ALUMNI ASSOCIATION AMERICAN UNIVERSITY OF BEIRUT

The Dental Alumni Association of the American University of Beirut will hold its fourth biennial conference in the dental school building in Beirut, Lebanon, during commencement week, in June. All ethical graduate dentists of the Near East are cordially invited to this meeting. The outstanding men in their lines of dentistry in the Near East will convene to present a program especially designed to be applicable to every type of dental practice. Members of the dental profession who expect to be on tour in these parts during the Spring are cordially invited to include Beirut and our dental school in their itinerary whether it be for the meeting or not. We also take this occasion to invite American and European dental manufacturers, whose exhibits have played an important part in the success of our past meetings, to lend their support to this meeting, which we hope to make the most successful dental meeting ever held in the near east.

Donald Clawson

ONTARIO DENTAL ASSOCIATION

The annual convention of the Ontario Dental Association will be held at the Royal York Hotel, Toronto, May 15-18.

Fred J. Conboy, *Secretary*
1348 Yonge St.
Toronto

AMERICAN DENTAL HYGIENISTS' ASSOCIATION

The tenth annual convention of the American Dental Hygienists Association will be held in Chicago, August 7-12, with headquarters at the Hotel Stevens.

Agnes G. Morris, *Secretary*
886 Main St.
Bridgeport, Conn.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

The Stevens Hotel has been designated as headquarters for the ninth annual meeting of the American Dental Assistants Association which will be held in Chicago, August 7-12. For further information, address

Ruth M. Clark, *General Secretary*
Scofield Bldg.
Minot, N. Dak.

AMERICAN HOME ECONOMICS ASSOCIATION

The twenty-sixth annual meeting of the American Home Economics Association will be held in Milwaukee, Wis., June 26-30.

OFFICE PLAN WANTED

William Cole, M.D., 320 Pine Ave., Long Beach, Calif., is interested in obtaining plans suitable for combined offices for a dentist and an internist. Readers associated with an internist are asked to forward to Dr. Cole a rough sketch of their office plan.

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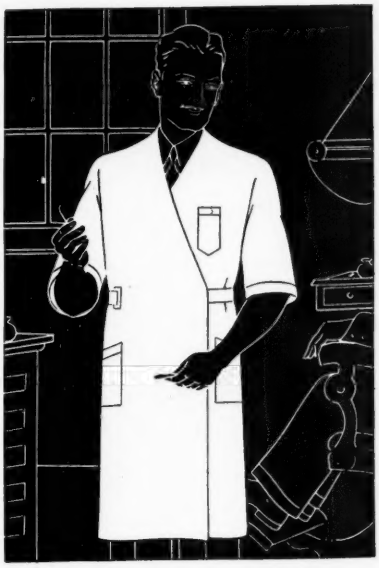

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